December 2000

Environmental Technology Verification Report

NO_x Control Technologies

Catalytica Combustion Systems, Inc. Xonon™ Flameless Combustion System

Prepared by

MRI
Midwest Research Institute

RTI
Research Triangle Institute

Under a Cooperative Agreement with

EPA United States Environmental Protection Agency

ETV ETV ETV

THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

U.S. Environmental Protection Agency

Research Triangle Institute

ETV Joint Verification Statement

TECHNOLOGY TYPE:	**NO_x AIR POLLUTION CONTROL TECHNOLOGY**		
APPLICATION:	**A PROCESS-INHERENT NO_x EMISSION CONTROL SYSTEM FOR GAS TURBINE APPLICATIONS**		
TECHNOLOGY NAME:	**XONON™ COOL COMBUSTION**		
COMPANY:	**CATALYTICA ENERGY SYSTEMS, INC.***		
ADDRESS:	**430 FERGUSON DRIVE** **MOUNTAIN VIEW, CA 94043-5272**	**PHONE:** **FAX:**	**(650) 960-3000** **(650) 960-0127**
WEB SITE:	**http://www.CatalyticaEnergy.com**		

* Catalytica Energy Systems, Inc. is the former Catalytica Combustion Systems, Inc. (CCSI)

The U.S. Environmental Protection Agency (EPA) has created the Environmental Technology Verification (ETV) Program to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV Program is to further environmental protection by substantially accelerating the acceptance and use of improved and cost-effective technologies. ETV seeks to achieve this goal by providing high-quality, peer-reviewed data on technology performance to those involved in the design, distribution, financing, permitting, purchase, and use of environmental technologies.

ETV works in partnership with recognized standards and testing organizations; with stakeholder groups that consist of buyers, vendor organizations, permitters, and other interested parties; and with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer-reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

The Air Pollution Control Technology (APCT) program, one of 12 technology areas under ETV, is operated by the Research Triangle Institute (RTI) in cooperation with EPA's National Risk Management Research Laboratory. Midwest Research Institute, on behalf of the APCT program, has evaluated the performance of a nitrogen oxides (NO_x) control technology utilizing flameless catalytic combustion for stationary gas turbines, Xonon™ Cool Combustion (formally known as Xonon™ flameless combustion.)

VERIFICATION TEST DESCRIPTION

All tests were performed in accordance with general guidance given by the APCT program "Generic Verification Protocol for NO_x Control Technologies for Stationary Combustion Sources" and the specific technology test plan "Verification Test/QA Plan for Xonon™ flameless combustion system." These documents include requirements for quality management, quality assurance, auditing of the test laboratories, and test reporting format.

The Xonon™ Cool Combustion system was tested as installed and operating on a Kawasaki M1A-13A gas-turbine-generator set (1.5 MW) located in Santa Clara, California, on July 18 and 19, 2000. NO_x concentrations were measured using continuous emission monitors (CEMs) following EPA Reference Method 20 for gas turbines. Other gaseous emissions were monitored using the applicable EPA test method. Other process variables were monitored using calibrated plant instrumentation.

Tests were conducted to meet the data quality objective of a 95 percent confidence interval with a width of ±10 percent or less of the mean NO_x emission concentration for concentrations above 5 ppmvd, ±25 percent or less below 5 ppmvd and above 2 ppmvd, and ±50 percent or less below 2 ppmvd. In addition to outlet NO_x concentration and the primary process variables, carbon monoxide and unburned hydrocarbon emission concentrations were also measured using EPA reference methods, and the installation efforts, site modifications, staffing, maintenance requirements, and similar issues were noted qualitatively.

A single test run consisted of measuring outlet NO_x concentration and the other parameters over a 32-min steady-state process condition with the primary variable, ambient temperature, at either its low point or high point (i.e., early morning or late afternoon). The test design was a replicated 2 × 1 factorial using two levels of ambient temperature and greater than 97 percent of the rated full load. A total of 12 test runs were conducted over the 2-day field test period. Ambient temperature variation was small over the test period. Table 1 gives the operating performance envelope over which the Xonon™ Cool Combustion system was verified.

Verification Statement Table 1. Verification Test Performance Envelope[a]

	Ambient Temperature, °C
Low	15
High	25

[a]At >97 percent of full turbine load.

DESCRIPTION OF XONON™ TECHNOLOGY

This verification statement is applicable to the Xonon™ Cool Combustion system for gas turbine applications without the air management system. The Xonon™ Cool Combustion system is completely contained within the combustion chamber of the gas turbine. Xonon™ Cool Combustion completely combusts fuel to produce a high-temperature mixture, typically about 1300 °C (2400°F). Dilution air is added to shape the temperature profile required at the turbine inlet.

The Xonon™ Cool Combustion system consists of four sections:

- **Preburner.** The preburner is used to preheat the air before it enters the catalyst module and during startup for acceleration of the turbine. The preburner tested as part of this verification was a lean, premixed combustor.
- **Fuel injection and fuel/air mixing system.** This unit injects the fuel and mixes it with the main air flow to provide a very well mixed, uniform fuel/air mixture to the catalyst.
- **Xonon™ catalyst module.** In the catalyst module, a portion of the fuel is combusted without a flame to produce a high-temperature gas.
- **Homogeneous combustion region.** Located immediately downstream of the catalyst module, the homogeneous combustion region is where the remainder of the fuel is combusted, and carbon monoxide and unburned hydrocarbons are reduced to very low levels (also a flameless combustion process).

The overall combustion process in the Xonon™ system is a partial combustion of fuel in the catalyst module followed by complete combustion downstream of the catalyst in the burnout zone. Partial combustion within the catalyst produces no NO_x. Homogeneous combustion downstream of the catalyst usually produces no NO_x, because combustion occurs at a uniformly low temperature. A small amount of fuel is combusted in the preburner to raise the compressed air temperature to about 470°C (880°F). NO_x in the turbine exhaust is usually from the preburner.

The design of each Xonon™ combustor is customized to the particular turbine model and operating conditions of the application and would typically be defined through a collaborative effort with the manufacturer of the turbine to integrate the hardware into the design. Catalytica Energy Systems, Inc. expects that the Xonon™ Cool Combustion technology incorporated in a Xonon™ combustion system for a natural-gas-fueled Kawasaki M1A-13A gas turbine is capable of achieving emissions of NO_x of less than 2.5 ppmvd (corrected to 15 percent oxygen [O_2]) on a 1-hour rolling average basis, and less than 2.0 ppmvd (corrected to 15 percent O_2) on a 3-hour rolling average basis. Under the same conditions, the Xonon™ combustion system is expected to achieve carbon monoxide (CO) emissions of less than 6 ppmvd (corrected to 15 percent O_2). The footprint may vary depending on the implementation, although generically the Xonon™ combustion system would likely be somewhat larger than the combustor that is typically supplied as standard equipment by the turbine manufacturer. Each unit could have multiple fuel inputs from separate control valves, and additional instrumentation for control and monitoring would be integrated into the turbine control system.

This verification statement covers application of the Xonon™ Cool Combustion system to small gas turbines operated at full load when combusting natural gas within the stated operating condition envelope. This unit was operated at the test site by the vendor, Catalytica Energy Systems, Inc., for over 4,000 hours before the verification test. Data from this long-term operating period have been submitted to a number of regulatory authorities for their review and evaluation. While these data and the instruments used were not verified during this test, within the operating condition envelope the results are generally consistent with the verification test results. Catalytica Energy Systems, Inc. should be contacted for these data or other information.

VERIFICATION OF PERFORMANCE

The verified NO_x emission results are given in Table 2. The analysis of variance between NO_x and ambient temperature indicated that ambient temperature did not affect NO_x emissions over the narrow range encountered during this verification test.

Verification Statement Table 2. NO_x Control Performance

Ambient Temperature Range	Percent of Full Turbine Load Range	Mean Outlet NO_x Concentration ppmvd @ 15% O_2	Half-Width of 95% Confidence Interval on Mean Outlet NO_x ppmvd @ 15% O_2
15 to 25°C (59 to 77°F)	98-99%	1.13	0.026

ppmvd = parts per million by volume dry basis.

CO emissions averaged 1.36 ppmvd at 15 percent O_2. Unburned hydrocarbon (UHC) emissions averaged 0.16 ppmv (wet basis reported as propane).

The APCT quality assurance (QA) Officer has reviewed the test results and quality control data and has concluded that data quality objectives given in the NO_x Control Technology generic verification protocol and test/QA plan have been attained. During the verification tests, the EPA and APCT QA staffs conducted a performance evaluation and a technical system audit at the field test site, which confirm that the verification test was conducted in accordance with the EPA-approved test/QA plan.

This verification statement verifies the NO_x emissions characteristics of the Xonon™ Cool Combustion system within the range of application tested (see Table 2). Extrapolation outside that range should be done with an understanding of the scientific principles that control the performance of the Xonon™ Cool Combustion system. Gas turbine users with NO_x control requirements should also consider other performance parameters such as service life and cost when selecting a NO_x control system.

In accordance with the NO_x Control Technology generic verification protocol, this verification report is valid indefinitely for application of the Xonon™ Cool Combustion system within the range of applicability of the statement.

Original signed by Hugh W. McKinnon *12/15/00*
Hugh W. McKinnon Date
Acting Director
National Risk Management Research Laboratory
Office of Research and Development
United States Environmental Protection Agency

Original signed by Jack R. Farmer *12/22/00*
Jack R. Farmer Date
Program Manager
Air Pollution Control Technology Program
Research Triangle Institute

Environmental Technology Verification Report

NO_x Control Technologies

Catalytica Combustion Systems, Inc. Xonon™ Flameless Combustion System

Prepared by

Craig Clapsaddle
Midwest Research Institute
5520 Dillard Road
Cary, NC 27511-9232

Douglas VanOsdell
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709

EPA Cooperative Agreement CR 826152-01-2

EPA Project Manager: Theodore G. Brna
Air Pollution Prevention and Control Division
National Risk Management Research Laboratory
Office of Research and Development
Research Triangle Park, NC 27711

December 2000

Notice

This document was prepared by Midwest Research Institute (MRI) under a contract with Research Triangle Institute (RTI) with funding from Cooperative Agreement No. CR826152-01-2 with the U.S. Environmental Protection Agency (EPA). The document has been subjected to RTI/EPA's peer and administrative reviews and has been approved for publication. Mention of corporation names, trade names, or commercial products does not constitute endorsement or recommendation for use of specific products.

Catalytica Combustion Systems, Inc. becomes Catalytica Energy Systems, Inc.

Catalytica Combustion Systems, Inc. (abbreviated in this report as CCSI), a subsidiary of Catalytica, Inc., reorganized into stand-alone, publicly-traded Catalytica Energy Systems, Inc., on December 18, 2000. The Xonon™ Cool Combustion technology, referred to in this report as Xonon™ flameless combustion, remains the same, and all references to CCSI should be understood to refer to Catalytica Energy Systems, Inc. Contact information in the verification statement and report has been updated.

Availability of Verification Statement and Report

Copies of the public Verification Statement and Verification Report are available from

1. **Research Triangle Institute**
   P.O. Box 12194
   Research Triangle Park, NC 27709-2194

   Web site: http://etv.rti.org/apct/index.html
   or http://www.epa.gov/etv/ *(click on partners)*

2. **USEPA / APPCD**
   MD-4
   Research Triangle Park, NC 27711

   Web site: http://www.epa.gov/etv/library.htm *(electronic copy)*
   http://www.epa.gov/ncepihom/

Acknowledgments

The authors acknowledge the support of all of those who helped plan and conduct the verification activities. In particular, we would like to thank Ted Brna, EPA's Project Manager, and Paul Groff, EPA's Quality Assurance Manager, both of EPA's National Risk Management Research Laboratory in Research Triangle Park, NC. We would also like to acknowledge the assistance and participation of all the Catalytica Combustion Systems, Inc., personnel who supported the test effort.

For more information on NO_x Control Technologies Verification Testing, contact

Douglas VanOsdell
RTI
P.O. Box 12194
Research Triangle Park, NC 27709
(919) 541-6785, dwv@rti.org

For information on Xonon™ Cool Combustion, contact

Chuck Solt
Catalytica Energy Systems, Inc.
430 Ferguson Drive
Mountain View, CA 94043-5272
(916) 729-5004
csolt@CatalyticaEnergy.com or catalytica@csolt.net

For commercial issues, contact

Joseph Cussen
Catalytica Energy Systems, Inc.
430 Ferguson Drive
Mountain View, CA 94043-5272
(650) 940-6393
jcussen@CatalyticaEnergy.com

Abstract

Nitrogen oxides (NO_x) air pollution control technologies (APCTs) are among the technologies evaluated by the APCT Environmental Technology Verification (ETV) Program. The APCT program developed the *Generic Verification Protocol for NO_x Control Technologies for Stationary Combustion Sources* to provide guidance on the verification of specific technologies. The critical performance factor for this verification is the NO_x emission concentration within the performance envelope of the test. This protocol was developed by RTI and MRI, reviewed and discussed by a technical panel of experts, and approved by EPA. The protocol states the critical data quality objectives for a NO_x control technology verification, as well as noncritical but still important measurements of other performance parameters.

The Catalytica Combustion Systems, Inc., Xonon™ flameless combustion system was submitted to the APCT ETV program for verification. A test/quality assurance (QA) plan, prepared in accordance with the generic verification protocol, addressed the site specific issues associated with the verification test. The verification was conducted the week of July 17, 2000, at the Xonon™ installation on a 1.5-MW gas turbine in Santa Clara, CA. The mean outlet NO_x concentration during the verification was determined to be 1.13 ppmvd at 15% O_2. The measured NO_x concentration was well within the stated data quality objective for the NO_x measurement. Other important performance and operating parameters were also measured.

Contents

Section **Page**

Contents (continued)

Appendixes

Figures

Tables

Acronyms/Abbreviations

ADQ	Audit of data quality
ANSI	American National Standards Institute
APCT	Air Pollution Control Technology
ASME	American Society of Mechanical Engineers
CCSI	Catalytica Combustion Systems, Inc., renamed Catalytica Energy Systems, Inc.
cfm	Cubic feet per minute
CO	Carbon monoxide
CV	Coefficient of variance
DQO	Data quality objective
EED	MRI's Environmental Engineering Division
EPA	Environmental Protection Agency
ETV	Environmental Technology Verification
fpm	Feet per minute
GVP	Generic Verification Protocol
HMI	Human/machine interface
IR	Infrared
ISO	International Standards Organization
MFC	Mass flow controller
MRI	Midwest Research Institute
NESHAP	National Emission Standard for Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
NO_x	Nitrogen oxides
OD	Outside diameter
PE	Performance evaluation
ppmv	Part per million by volume
ppmvd	Part per million by volume dry basis
ppmvw	Part per million by volume wet basis
QA	Quality assurance
QAO	Quality assurance officer
QC	Quality control
QMP	Quality management plan
QSM	Quality system manual
RH	Relative humidity
RTI	Research Triangle Institute
SOP	Standard operating procedure
SS	Stainless steel
TEI	Thermo Enviromental Instruments, Inc. (sometimes identified as TECO)
TSA	Technical systems audit
UHCs	Unburned hydrocarbons (same as total hydrocarbons)

Section 1.0

Introduction

The objective of the Air Pollution Control Technology (APTC) Environmental Technology Verification (ETV) Program is to verify, with high data quality, the performance of air pollution control technologies. A subset of air pollution control technologies is nitrogen oxides (NO_x) emission control technologies. One of these NO_x emission control technologies is the flameless combustion system known as Xonon™, developed by Catalytica Combustion Systems, Inc. (CCSI) of Mountain View, California. The Xonon™ flameless combustion system is an advanced combustion process designed for gas turbines that is capable of producing NO_x emissions below the current level of 9 to 25 parts per million by volume on a dry basis (ppmvd) at 15 percent oxygen (O_2) obtainable with dry, low-NO_x combustion techniques.

Control of NO_x emissions is of increasing interest, particularly related to the National Ambient Air Quality Standard for ozone. The Environmental Protection Agency (EPA) recently completed a rulemaking to reduce more than 1 million tons of NO_x each ozone season and offered to develop and administer a multistate NO_x trading program to assist the affected states. Additionally, many state and local permitting agencies are requiring unprecedentedly low NO_x emission levels.

To evaluate the performance of the Xonon™ flameless combustion system, a field test program was designed by Research Triangle Institute (RTI) and Midwest Research Institute (MRI) with assistance from CCSI. A site visit to the host facility was completed on April 17, 2000, and a test/QA plan was developed and approved by EPA on June 28, 2000. The verification field test was conducted on July 18 and 19, 2000.

The host facility was the Silicon Valley Power Gianera generating station located at 4948 Centennial Drive in Santa Clara, California. The Xonon™ flameless combustion system was installed on a 1,500-kW gas-turbine-generator set manufactured by Kawasaki (Model M1A-13A).

The verification statement for the Xonon™ flameless combustion system verification test is presented in the preceding section. A detailed description of the Xonon™ flameless combustion system is presented in Section 2. The procedures and methods used for the verification test are discussed in Section 3. The operating range over which the verification test was conducted is presented in Section 4. The results of the verification test are summarized and discussed in Section 5.

Appendices describing QA/QC activities and results (Appendix A), raw test data (Appendix B), and equipment calibration results (Appendix C) are attached.

Section 2.0

Description and Identification of Xonon™ Flameless Combustion System

The Xonon™ flameless combustion system is completely contained within the combustion chamber of the gas turbine. The Xonon™ system completely combusts fuel to produce a high-temperature gaseous mixture, typically over 1300 °C (2400°F). Dilution air is added to shape the temperature profile required at the turbine inlet.

The Xonon™ combustor consists of four sections:

1. **Preburner**. The preburner is used for startup preheat of air before it enters the catalyst module and acceleration of the turbine. The preburner could be a conventional, diffusion flame burner or could be a dry, low-NO_x type (lean, premixed) burner. For this Kawasaki turbine, the preburner was a lean premix burner.

2. **Fuel injection and fuel/air mixing system**. This system injects the fuel and mixes it with the main air flow to provide a very well-mixed, uniform fuel/air mixture to the catalyst.

3. **Xonon™ catalyst module**. In the catalyst module, a portion of the fuel is combusted without a flame to produce a high-temperature gas.

4. **Homogeneous combustion region**. Located immediately downstream of the catalyst module, the homogeneous combustion region is where the remainder of the fuel is combusted, and carbon monoxide and unburned hydrocarbons are reduced to very low levels (also a flameless combustion process).

The overall combustion process in the Xonon™ system is a partial combustion of fuel in the catalyst module followed by complete combustion downstream of the catalyst in the burnout zone. Partial combustion within the catalyst produces no NO_x. Homogeneous combustion downstream of the catalyst usually produces no NO_x, because combustion occurs at a uniformly low temperature. A small amount of fuel is combusted in the preburner to raise the compressed air temperature to about 470°C (880°F). NO_x in the turbine exhaust is usually from the preburner.

The design of each Xonon™ combustor is customized to the particular turbine model and operating conditions of the application and would typically be defined through a collaborative effort with the manufacturer of the turbine to integrate the hardware into the design. The footprint may vary depending on the implementation, although generically the Xonon™ combustion system would likely be somewhat larger than the combustor that is typically supplied as standard equipment by the turbine manufacturer. Each unit could have multiple fuel inputs from separate control valves, and additional instrumentation for control and monitoring would be integrated into the turbine control system.

When a Xonon™ combustion system is installed, initial startup and shakedown are supervised by CCSI personnel, and the requisite training to operate and service the equipment is provided at that time. Maintenance procedures and spare parts requirements are identified during design of the combustor for the specific turbine model, and this information is provided upon delivery of the equipment. CCSI indicates the elapsed time between installation and commissioning to be less than 1 month.

After initial commissioning, the Xonon™ combustion system is expected to require minimal ongoing service. CCSI expects the catalyst module to have a useful life of approximately 8,000 operating hours, requiring a replacement of the module at this interval.

This verification report covers application of the Xonon™ flameless combustion system to small gas turbines operated at full load when combusting natural gas within the stated operating condition envelope. The same pilot unit was operated at the test site by the vendor, CCSI, for over 4,000 hours before the verification test. Data from this long-term operating period have been submitted to a number of regulatory authorities for their review and evaluation. While these data and the instruments used were not verified during this test, within the operating condition envelope the results are generally consistent with the verification test results. CCSI should be contacted for these long-term data or other information.

CCSI Xonon™ Product Performance Expectations

CCSI expects that the Xonon™ flameless combustion technology incorporated in a Xonon™ combustion system for a natural-gas-fueled Kawasaki M1A-13A gas turbine is capable of achieving emissions of NO_x of less than 2.5 ppmvd (corrected to 15 percent oxygen [O_2]) on a 1-hour rolling average basis, and less than 2.0 ppmvd (corrected to 15 percent O_2) on a 3-hour rolling average basis. Under the same conditions, this Xonon™ combustion system is also expected to achieve carbon monoxide (CO) emissions of less than 6 ppmvd (corrected to 15 percent O_2).

Section 3.0

Procedures and Methods Used in Testing

A generic verification protocol (GVP) for testing NO_x control technologies was prepared and approved by the NO_x Control Technology Technical Panel (RTI, 2000a). The GVP established the guidelines for the verification test design, the data quality objective (DQO) for the primary verification parameter (for this verification test, NO_x concentration corrected to 15 percent O_2), and the test methods to be used. A test/QA Plan (RTI, 2000b) was written to apply the GVP to the Xonon™ verification. This section details the test design and the test methods used for the verification test of the Xonon™ flameless combustion system.

3.1 Test Design

The GVP for NO_x Control Technologies provides extended discussions on the experimental design approach for NO_x control technologies verification testing. The specific design for this test is described below.

The critical measurement for the Xonon™ flameless combustion system verification was the level of NO_x emitted in ppmvd at 15 percent O_2. This verification test was designed to measure the outlet NO_x emission concentration under targeted field test conditions with the Xonon™ flameless combustion system operating at a specified high load and the encountered low and high ambient temperature for the test days. Historical ambient temperature data suggested that its effect might be detectable by conducting sets of tests at dawn (cold) and in the afternoon (hot). Associated emissions concentrations were also measured using EPA reference methods, but the test was not designed around acquisition of these data. Ambient temperature was an important measurement for establishing the bounds of the verification test design.

A 2 × 1 factorial experimental design was used with each of the parameters. Two replications of the factorial design (six test runs in each replication) was used for a total of 12 test runs. Table 1 gives the factorial design with the target values for each parameter. As required by the DQO, the product of this test design was the verified mean NO_x emission concentration(s) and the achieved 95 percent confidence interval of the mean for the specified operating range.

The factorial design allowed for statistical significance tests to determine whether the outlet NO_x concentration varied significantly with ambient temperature. Further, since two replicates were done, the significance of interactions between ambient temperature and outlet NO_x concentration

Table 1. Verification Test Design (Target Values)[a]

Test Run	Ambient Temperature (time of day)
1	Low (dawn)
2	Low (dawn)
3	Low (dawn)
4	High (afternoon)
5	High (afternoon)
6	High (afternoon)
7	Low (dawn)
8	Low (dawn)
9	Low (dawn)
10	High (afternoon)
11	High (afternoon)
12	High (afternoon)

[a] Turbine load >95% maximum.

could also be tested. If the outlet NO_x concentration did not change significantly with ambient temperature, the results are valid for the range of ambient temperature covered by the test. If the outlet NO_x concentration did vary significantly with ambient temperature, the results need to include information indicating the dependence of outlet NO_x concentration on ambient temperature. The results of the statistical significance tests are presented in Section 5.1.1.

Because the turbine was operated at constant full load (>97%) during the entire testing period, the process was assumed to be at equilibrium during all testing.

3.2 Sampling Methods

Table 2 lists all the measurement parameters for this verification test. They are categorized in the table as performance factors (e.g., direct emission measurements), associated impacts (e.g., CO and UHC emissions), and test conditions that were documented. Included in Table 2 are the factors to be verified, parameters to be measured for each factor, the measurement method for each parameter, and explanatory comments. The facility contact provided data for process condition parameters collected from the turbine human/machine interface (HMI) computer. Measurement methods and procedures are described in Sections 3.2.2 through 3.2.5.

3.2.1 Sampling Locations

Sample locations were chosen so that they met the minimum specified sample location criteria of the sample methods used or yielded a representative sample. The pollutant emission sampling location, process operating condition measurement locations, and ambient conditions measurement location are presented in Sections 3.2.1.1 through 3.2.1.3, respectively.

3.2.1.1 Pollutant Emission Sampling Location—

The NO_x, CO, UHC, O_2, and CO_2 concentrations were measured in the turbine exhaust stack (see Figure 1). Two sets of sampling ports were available, but neither met Method 20 criteria. As noted in the test/QA plan, the top set of sampling ports were judged as the most likely to yield a representative sample; therefore, the top sampling ports were used.

3.2.1.2 Process Conditions Measurement Locations—

Several parameters related to the operating conditions of the gas turbine during the verification test runs were recorded. These include electric power output, fuel flow rate, inlet temperature to the compressor, compressor discharge pressure, compressor discharge temperature, temperature into the catalyst, temperature out of the catalyst, and the exhaust gas temperature. The measurement locations for process and turbine parameters are identified in Figure 2 and are in relation to where the measurements are taken in the gas turbine.

Table 2. Summary of Measurements

Factors to be Verified	Parameter to be Measured	Measurement Method	Comments
Performance factors			
NO_x emissions	Outlet NO_x conc., ppmv	EPA Ref. Method 20 (40 CFR 60 App. A)	MRI provided and operated analyzer
Associated impacts			
CO emissions	Outlet CO conc., ppmv	EPA Ref. Method 10 (40 CFR 60 App. A)	MRI provided and operated analyzer
UHC emissions	Outlet THC conc., ppmvw	EPA Ref. Method 25A (40 CFR 60 App. A)	MRI provided and operated analyzer
O_2/CO_2 emissions	Outlet O_2/CO_2 conc.,%	EPA Ref. Method 20 (40 CFR 60 App. A)	MRI provided and operated analyzer
Test conditions documentation			
Percent of turbine's rated capacity	Electrical power ÷ turbine rating	Real power sensor	MRI collected data from facility contact
Fuel type	---	---	Natural gas
Fuel flow	Fuel flow rate	Coriolis-type flowmeter	Facility contact provided data from turbine HMI computer
Fuel sample results	Natural gas composition	Chromatographic analysis	From fuel sample results obtained from CCSI
Ambient conditions	Air temperature	Thermocouple or Thermohygrometer following EPA Quality Assurance Handbook for Air Pollution Measurement Systems, *Volume IV: Meteorological Measurements*	MRI conducted temperature, pressure, and humidity measurements concurrently
	Air pressure	ASTM D3631-95: aneroid barometer or equivalent	
	Air humidity	Thermohygrometer equivalent to ASTM E337-84(1996)e1	
Compressor parameters	Inlet temperature	Array of thermocouples on turbine	Facility contact provided data from turbine HMI computer
	Discharge temperature	Array of thermocouples on turbine	Facility contact provided data from turbine HMI computer
	Discharge pressure	Pressure gauge	Facility contact provided data from turbine HMI computer
Catalyst inlet condition	Temperature at catalyst inlet	Array of thermocouples on turbine	Facility contact provided data from turbine HMI computer
Catalyst outlet condition	Temperature out of the catalyst	Array of thermocouples on turbine	Facility contact provided data from turbine HMI computer
Catalyst hours of operation	Hours of operation since catalyst installed	Clock counter	Information provided by CCSI facility contact
Exhaust temperature	Exhaust gas temperature	Array of thermocouples on turbine	Facility contact provides data from turbine HMI computer
Compressor/turbine status	---	Pressure ratio compared to rated value	Information provided by CCSI facility contact

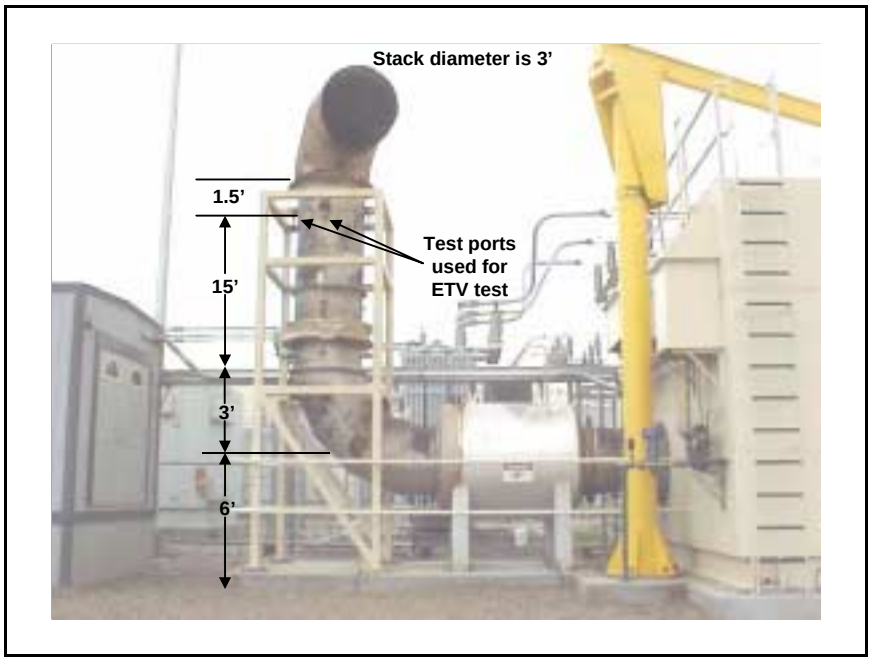


Figure 1. Turbine exhaust sampling location.

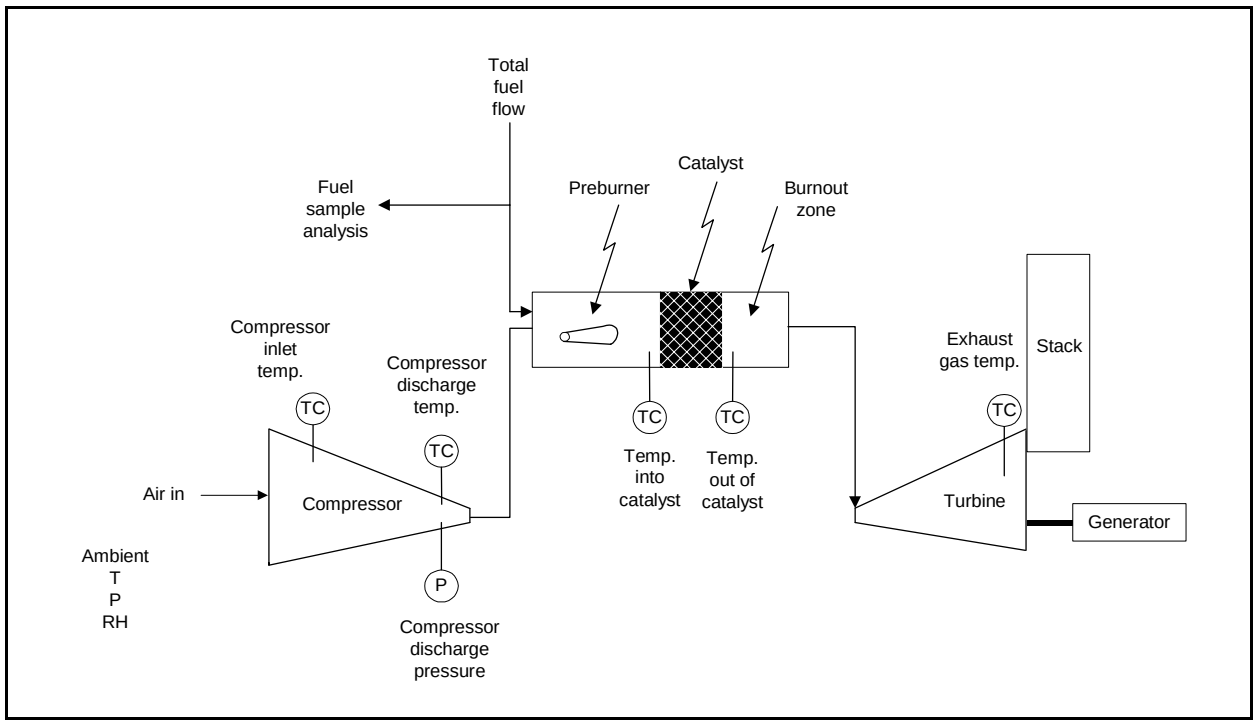


Figure 2. 1.5-MW gas turbine.

3.2.1.3 Ambient Conditions Measurement Location—

Parameters related to the ambient conditions during the verification test runs include the ambient air temperature, ambient air pressure, and ambient relative humidity. The measurement location for the ambient conditions is shown in Figure 3. The temperature (T), pressure (P), and relative humidity (RH) measurement devices were placed on the platform just below the gas turbine air inlet filters. In this location, the measurements are representative of the inlet air conditions (as recommended in Section 4.3.4 of *EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements*, Templeman, 1995). An aspirated radiation shield was used to prevent biases caused by direct sunlight exposure.

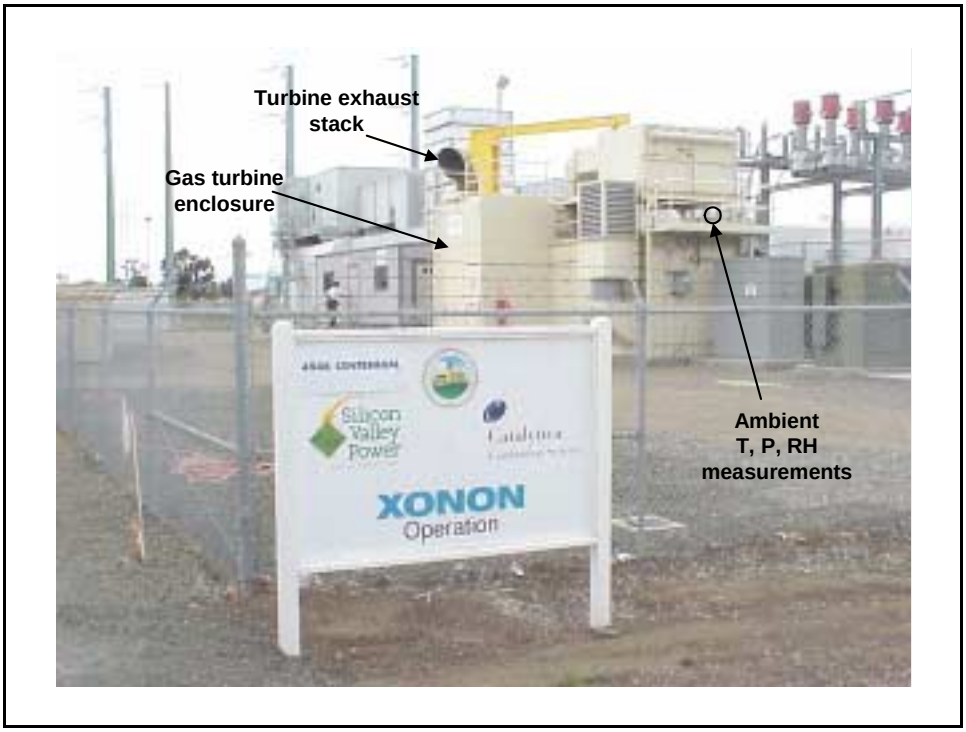


Figure 3. Ambient conditions sampling location.

3.2.2 NO_x, CO, UHC, and O_2/CO_2 Sampling Procedures

Turbine exhaust gas was sampled for NO_x, CO, UHC, and O_2/CO_2 using EPA reference methods. All sampling followed the requirements of the specific test method being used unless otherwise stated in this document or approved by RTI before the verification test. The analytical systems were calibrated before and after each 32-min test run following the procedures in each applicable EPA Reference Method (40 CFR 60 App. A).

3.2.2.1 Sampling System—

A diagram of the extractive gaseous measurement system used for the testing is shown in Figure 4. Two independent sampling systems were used, one for CO, O_2, CO_2, and NO_x and

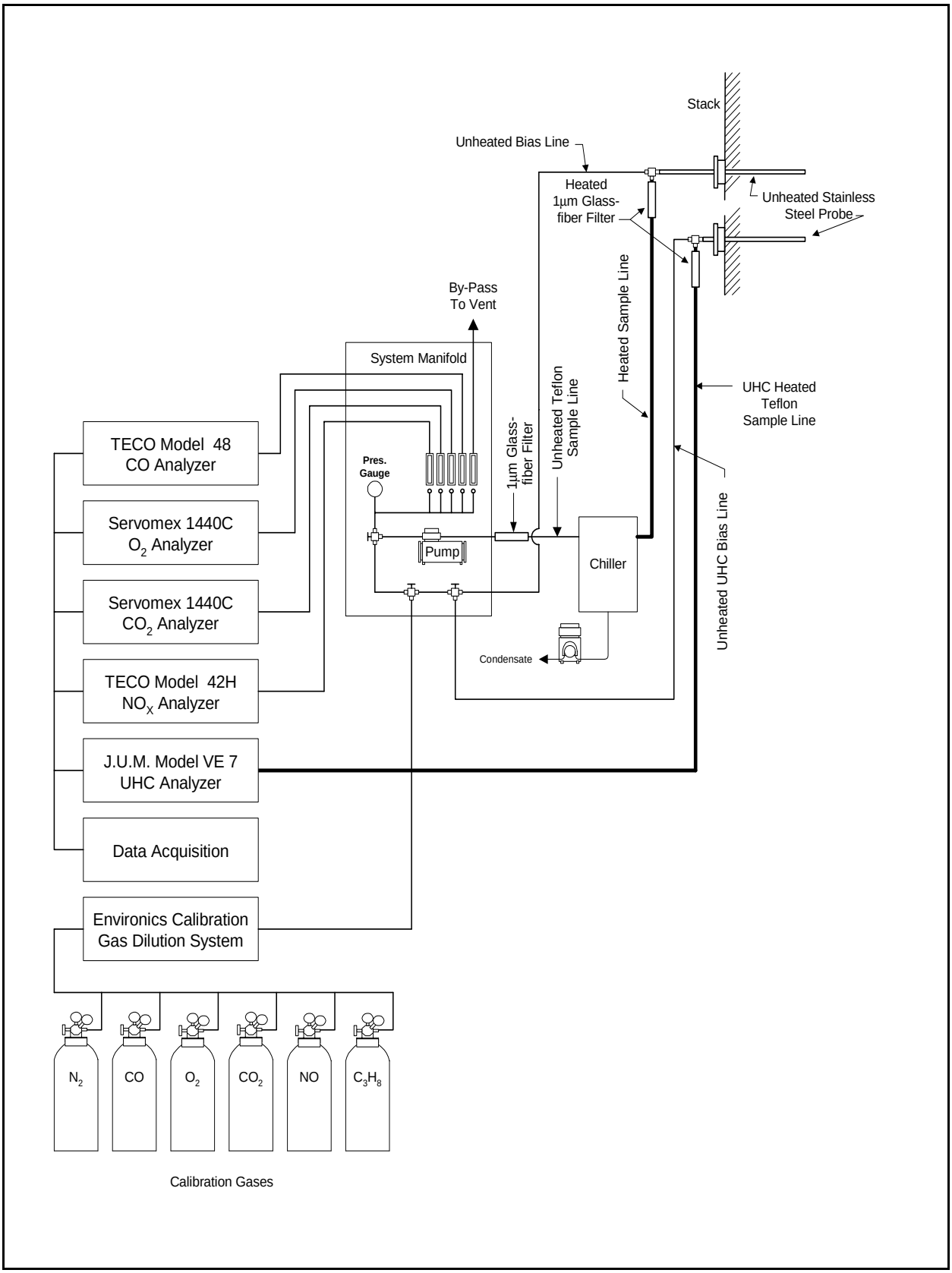


Figure 4. Extractive sampling system

another for UHC. All analyzers, calibration gases, and the sampling manifold were housed in an environmentally controlled trailer. The sampling system components were stainless steel (SS), Teflon, or glass. These materials have been proven to be inert for the gases of interest.

The sampling system for measurement of CO, O_2, CO_2, and NO_x consisted of

- Unheated stainless steel probe; 1.27 cm (0.5 in.) outside diameter (OD) (since the stack gas temperature was ~ 510°C [950°F], the probe was not heated);
- Heated (~121°C [250°F]) glass-fiber filter to remove particles with a diameter >1 µm;
- Heated (~121°C [250°F]) Teflon sample line (~3 m [10 ft] long and 0.95 cm [0.38 in.] OD) to transport the sample gas to the moisture removal condenser; temperature of the sample line was regulated with a thermostatic heat controller;
- Chiller condenser system submerged in an ice bath to condense and remove moisture in the sample gas; the condenser is a two-pass system to condense moisture while minimizing the liquid/air interface; a peristaltic pump was used to continually remove condensed water vapor; the water vapor dewpoint after the chiller was estimated to be ~ 3.5°C (38°F);
- Unheated Teflon sample line (~ 2.3 m [75 ft] long and 0.95 cm [0.38 in.] OD) to transport the sample gas from the chiller (located on the scaffold platform near the sample ports) to the sample manifold; just upstream of the sample extraction pump was a second glass-fiber filter;
- Teflon-lined sample pump to extract sample gas from the stack; sampling rate was ~ 10 L/min; and
- Individual rotameters regulated the sample flow to each analyzer and excess sample gas was dumped through the bypass.

The sampling system for measurement of UHCs consisted of

- Unheated SS probe; 1.27 cm (0.5 in.) OD;
- Heated (~121°C [250°F]) glass-fiber filter to remove particles with a diameter >1 µm;
- Heated (~121°C [250°F]) Teflon sample line (~23 m [75 ft] long and 0.63 cm [0.25 in.] OD) to transport the sample gas directly to the hydrocarbon analyzer; temperature of the sample line was regulated with a thermostatic heat controller; and
- Sample gas was extracted by a heated pump contained within the hydrocarbon analyzer.

The sampling system was calibrated by directing each calibration gas to the probe through an unheated Teflon tube. The probe was "flooded" with calibration gas, and the sample pump pulled as much of the calibration gas as needed to the system manifold. Excess calibration gas was dumped out the probe. This process of calibrating the system does not pressurize the sampling system and mask any leaks (see Section 3.2.3.5.2 for description of CO analyzer calibration).

Calibration gases were generated from a single, high-concentration EPA protocol gas with an Environics Model 2020 gas dilution system. The Environics system consists of four electronic

mass flow controllers (MFCs). MFC 1 was used for the nitrogen dilution gas. MFC 2 (0 to 10 L/min) and MFC 3 (0 to 1 L/min) are used in combination with MFC 1 to generate the specified calibration gas concentration by diluting a high concentration standard gas. MFC 4 (0 to 0.1 L/min) was not used. The Environics system was calibrated at the factory on July 11, 2000. Also, the calibration of the combined MFCs that were used for this test (e.g., 1 + 2 and 1 + 3) was checked in accordance with EPA Method 205 the day before the field test began. The Method 205 data are summarized in Section 5.

3.2.2.2 Reference Analyzers—

The reference analyzers used for quantifying the gaseous concentrations are listed in Table 3. The table also includes a description of the analyzer and the measurement ranges used for this test. Measured pollutant concentrations were extremely low relative to the measurement ranges. Most notably, the UHC concentrations were about 0.1 to 0.2 part per million by volume on a wet basis (ppmvw) as measured on a 0- to 100-ppmvw range. Method 25A specifies a measurement range of 1.5 times the expected concentration, which is unfeasible at extremely low concentrations.

Table 3. Reference Analyzers and Measurement Ranges

Pollutant	Reference Analyzer	Measurement Range	Description
NO_x	Thermo Environmental Instruments (TEI) 42H	0-20 ppmv	Uses the principle of chemiluminescence to measure the concentration of NO_x in the sample stream. The instrument uses a heated can NO_2 converter.
CO	Thermo Environmental Instruments (TEI) 48	0-50 ppmv	Uses the principle of gas filter correlation and non-dispersive infrared (GFC-NDIR) to measure the concentration of CO in the sample stream.
UHC	J.U.M VE 7	0-100 ppmvw	Uses the principle of flame ionization detection (FID) to measure the concentration of hydrocarbons in the sample stream.
O_2/CO_2	Servomex 1440C	0-25% / 0-20%	The O_2 detector uses the principle of paramagnetics, and the CO_2 detector uses a single- beam, dual-wavelength IR technique.

3.2.3 Sampling Methods Requirements

Each of the sampling methods has different criteria to ensure the quality of the sample and the data collected. Each of these requirements is presented in the following sections.

3.2.3.1 Analyzer Interference Test—

An initial interference check was completed on the NO_x, CO, O_2, and CO_2 analyzers before their first use. For the interference test, the gases listed in Table 4 were injected into each analyzer. For acceptable analyzer performance, the sum of the interference responses to all of the interference gases must be $\leq$2 percent of the analyzer span value. The interference test results are presented in Section 5.

3.2.3.2 NO_2 Converter Efficiency Test—

Table 4. Gas Analyzers Interference Test Gas Concentrations

CO	SO_2	CO_2	O_2
NO_x Analyzer Interference Gases			
498 ppmv	201 ppmv	9.98%	20.9%
CO Analyzer Interference Gases			
NA	NA	9.98%	NA
O_2 Analyzer Interference Gases			
498 ppmv	197 ppmv	9.98%	NA
CO_2 Analyzer Interference Gases			
498 ppmv	197 ppmv	NA	20.9%

NA = Not applicable.

The NO_2 converter efficiency is tested as part of routine analyzer QC Method 20. The test relies on the oxidation reaction of NO in the presence of oxygen. NO reacts to form NO_2 in equilibrium with NO. For the test, a clean, leak-free Tedlar bag was filled half full with the mid-level NO calibration gas. The bag was then filled with 20.9 percent O_2 gas. The bag was attached directly to the NO_x analyzer sample inlet. After approximately a 2-min stabilization period, 30 1-min average NO_x analyzer readings were recorded. For an acceptable converter, the 1-min average response at the end of 30 min is required to not decrease more than 2 percent of the highest peak 1-min value. That is, the analyzer should be capable of converting all the NO to NO_2. The results of the NO_2 converter efficiency check are presented in Section 5.

3.2.3.3 Response Time Test—

3.2.3.3.1 Method 20 Response Time - NO_x and O_2/CO_2. To determine the response time according to Method 20 procedures, the zero gas (i.e., N_2) was injected into the sampling system at the probe. When the analyzer's readings were stable, the zero gas was turned off so the effluent could be sampled. When a stable reading was obtained, the upscale response time was determined as the time required for the computer readout to record a 95 percent step change from the zero reading to the stable effluent concentration. Then the high-level calibration gas for each analyzer was injected into the sampling system at the probe. When the analyzer's readings were stable, the high-level gas was turned off so that the effluent could be sampled. When a stable reading was obtained, the downscale response time was determined as the time required for the computer readout to record a 95 percent step change from the calibration gas reading to the stable effluent concentration. This procedure was repeated until three upscale and three downscale response times were completed. The longest of all the upscale and downscale response times was reported as the system response time for that analyzer. For Method 20, the response time must be 30 s or less. The response times are presented in Section 5, Table 13.

3.2.3.3.2 Method 25A Response Time - UHC. For EPA Method 25A, only an upscale response time test is required. To determine the upscale response time, the zero gas was injected into the sampling system at the probe. Then, the high-level calibration gas was injected into the sampling system. The upscale response time was determined as the time required for the computer readout to reach 95 percent of the high-level calibration gas reading. This procedure

was repeated three times, and the average was reported as the response time. The response time is presented in Section 5, Table 13.

3.2.3.4 Preliminary O_2 Traverse—

Method 20 requires a preliminary O_2 traverse to be conducted at multiple sample points across the stack's cross-sectional area. The preliminary O_2 traverse determines the eight lowest O_2 concentration sampling points from an array of multiple points. These eight low O_2 points are used as the traverse points for the individual test runs. However, since this stack had a cross-sectional area of 0.66 m^2 (7.1 ft^2), only eight traverse points would be used for the preliminary O_2 traverse. Therefore, a preliminary O_2 traverse was not necessary and was not done, and eight traverse points for the test runs were selected in accordance with EPA Method 1.

3.2.3.5 Calibrations—

Table 5 lists the calibration gas concentrations used for the reference method testing. EPA protocol gas was used to calibrate the analyzers. Each of the reference methods has different calibration procedures. The individual method calibration procedures are described in Sections 3.2.3.5.1 through 3.2.3.5.3. The gaseous pollutant measurement system was calibrated before and after each test run. Also, no test run started more than 2 hours after a pretest calibration, and all post-test calibrations were completed within 1 hour of the end of a test run.

Table 5. Calibration Gas Concentrations

Calibration point	O_2	CO_2	NO_x	CO	UHC
Zero	Pure N_2	Pure N_2	Pure N_2	Pure N_2	Pure N_2
Low-level	NA	NA	5.02 ppmv	15.0 ppmv	29.9 ppmv
Mid-level	11.99%	3.01%	10.03 ppmv	29.9 ppmv	49.9 ppmv
High-level	20.9%	9.98%	17.04 ppmv	44.9 ppmv	84.9 ppmv

3.2.3.5.1 Method 20 Calibration Procedures. The NO_x calibration gas was 201.85 ppmv NO in a balance of N_2. The O_2 calibration gas was 38.4 percent O_2 in a balance of N_2. The CO_2 calibration gas was 40.05 percent CO_2 in a balance of N_2. Copies of the calibration gas certifications are attached in Appendix A. As noted earlier, a gas dilution system was used to make the targeted gas concentration levels shown in Table 5 from the single, high-concentration EPA protocol gas.

For calibration error checks of both the NO_x and diluent analyzers, the zero gas and mid-level gas were introduced separately into the sampling system at the probe. Each analyzer's response was adjusted to the appropriate level. Then the remainder of the calibration gases were introduced into the sampling system, one at a time. The acceptable response of the analyzer to each calibration gas must be within ±2 percent of span.

At the conclusion of a test run, the zero and mid-level calibration gases for each analyzer were introduced separately into the sampling system. Both the zero drift and calibration drift, calculated in accordance with Equation 1, must be within ±2 percent of span. If a drift was greater than 2 percent of span, the test run would have been considered invalid and the measurement system would have been repaired to satisfy drift tolerances before additional test runs were conducted. Method 20 calibration results are summarized in Section 5. Individual pre- and post-test run calibrations are presented in Appendix B.

$$\text{Percent drift} = (\text{Final response} - \text{Initial response}) / \text{Span value} \times 100 \quad (1)$$

3.2.3.5.2 Method 10 Calibration Procedures. The CO calibration gas was 199.8 ppmv CO in a balance of N_2. The calibration gas certification is shown in Appendix A. The gas dilution system was used to make the targeted gas concentration levels from the single, high-concentration EPA protocol gas.

CO analyzer calibration error checks were conducted before the start of each day's testing. The calibration error check was conducted (after final calibration adjustments were made) by separately injecting each of the four calibration gases (zero, low-, mid-, and high-level) directly into the analyzer and recording the response. If the calibration error was greater than 2 percent, the analyzer would have been repaired or replaced and recalibrated to an acceptable calibration error limit before proceeding.

Zero and upscale sampling system calibration checks were performed both before and after each test run to quantify the reference measurement system calibration drift and the sampling system bias. Upscale calibration checks were performed using the mid-level gas. During these checks, the calibration gases were introduced into the sampling system at the probe so that they were sampled and analyzed in the same manner as the sample gas. Drift means the difference between the pre- and post-test run system calibration check responses. Sampling system bias means the difference between the system calibration check response and the initial calibration error response (direct analyzer calibration) at the zero and upscale calibration gas levels. Method 10 calibration results are summarized in Section 5. Individual pre- and post-test run calibrations are presented in Appendix B.

3.2.3.5.3 Method 25A Calibration Procedures. The UHC calibration gas was 190.6 ppmv propane in a balance of nitrogen. Copies of the calibration gas certification are located in Appendix B. The gas dilution system was used to make the targeted gas concentration levels shown in Table 5 from the single, high-concentration EPA protocol gas.

For calibration error checks, the zero gas and high-level gas were introduced separately into the sampling system at the probe. The UHC analyzer's response was adjusted to the appropriate level. Then the low- and mid-level calibration gases were introduced into the sampling system, one at a time. The acceptable response of the analyzer to each calibration gas must be within ±5 percent of the calibration gas value.

At the conclusion of a test run, the zero and mid-level calibration gases were introduced separately into the sampling system. Both the zero drift and calibration drift, calculated in accordance with Equation 1, must be within ±3 percent of span. If a drift was greater than 3 percent of span, the test run would have been considered invalid, and the measurement system would have been repaired before additional test runs were conducted. Method 25A calibration results are summarized in Section 5. Individual pre- and post-test run calibrations are presented in Appendix B.

3.2.3.6 CO_2 Trap—

Method 10 requires that CO_2 be removed from the sample gas that is sent to the CO analyzer. The CO_2 is removed because the commonly used, nondispersive infrared technology instrument for measurement of CO exhibits an interference from CO_2. However, the TEI Model 48 incorporates the technique of gas filter correlation to eliminate the CO_2 interference from the measurement of CO. Since the TEI Model 48 does not have a CO_2 interference (see the interference test results in Section 5), the CO_2 trap was not used.

3.2.3.7 Sample Location by Method 20 and Traverse Point Selection by Method 1—

Two sets of sampling ports were available on the turbine exhaust stack. One set was located immediately after a long 90° horizontal-to-vertical upward bend in the stack. The second set was located approximately 4.6 m (5 duct diameters) downstream of the 90° horizontal-to-vertical upward bend and 0.5 m (0.5 duct diameters) upstream of the stack exit. Neither of these port locations is ideal; however, the top ports were used (see Figure 1). Only one of the top ports was used for the Method 20 traverse because the scaffold was only set up on one side of the circular stack. Therefore, MRI did not have safe access to the second port for the Method 20 traverse. Because the gas concentration was not stratified across the one available diagonal traverse, all parties agreed that double traversing across the single port was acceptable. Table 6 shows the point locations.

Table 6. Method 20 Traverse Points

Point	Percent of Stack Diameter	Distance from Stack Wall (cm)
1	6.7	(0.9)
2	25.0	(3.5)
3	75.0	(10.6)
4	93.3	(13.2)

3.2.4 Process Data Collection

Process data were collected from the turbine control's HMI computer to document the test conditions. The CCSI facility contact provided the data from the HMI computer. Table 2 identifies the parameters that were measured and the party responsible. The test condition documentation parameters taken from the HMI computer were retrieved at 1-min intervals for each test run. Process data, at 1-min intervals for each test run, are presented in Appendix C. The process data measurements are summarized in Sections 3.2.4.1 through 3.2.4.6.

3.2.4.1 Electrical Power Generation by Turbine —

To determine the operating rate of the turbine during the verification test, the electrical power production from the electrical generator was recorded. This measurement was taken with a Real Power Sensor that determines the electrical power supplied at the generator terminals. At this writing, CCSI is not aware of any calibration of this device since commissioning of the site in October 1998. The output has been noted by CCSI to be consistent with the City of Santa Clara meter on several occasions.

3.2.4.2 Fuel Flow Rate—

The fuel flow rate into the combustion system was measured with a Coriolis-mass flowmeter. The flowmeter was calibrated for natural gas at the factory and was recalibrated on June 28, 2000. (The flowmeter is periodically compared to the City of Santa Clara's main turbine flowmeter.)

3.2.4.3 Compressor Inlet Temperature—

Compressor inlet temperature (also referred to as "ambient temperature" by the facility) was measured with two 1/8-in. diameter sheathed K-type thermocouples located in the inlet air duct. These devices are calibrated on a semiannual basis using a calibrated thermowell device.

3.2.4.4 Compressor Discharge Pressure—

Compressor discharge pressure was measured using two pressure taps and two absolute pressure transducers. The transducers were originally calibrated at the factory and are periodically re-calibrated by CCSI personnel using specially maintained and calibrated pressure-sensing devices. The absolute pressure transducers were last calibrated in March 2000.

3.2.4.5 Catalyst Inlet/Catalyst Outlet Temperatures—

The air temperature just upstream of the catalyst and the gas temperature just downstream of the catalyst were measured by separate thermocouple arrays. The catalyst outlet temperature was measured with a series of four to eight thermocouples installed at the exit from the catalyst bed. The thermocouples are calibrated by CCSI personnel whenever the thermocouple hardware is changed.

3.2.4.6 Turbine Exhaust Temperature—

The turbine outlet temperature was measured by four 1/8-in. diameter sheathed K-type thermocouples installed at the exit of the turbine, just upstream of the stack's silencer. These thermocouples were factory calibrated, were recalibrated by CCSI personnel upon receipt, and were recalibrated upon installation in the spring of 2000.

3.2.5 Ambient Conditions Sampling

Three ambient air conditions were measured three times during each test run: temperature, pressure, and relative humidity. Temperature and humidity were measured using an equivalent technique to ASTM E337-84(1996)e1. ASTM E337-84(1996)e1 uses an aspirated wet-bulb and dry-bulb device to determine relative humidity, but MRI used a thermohygrometer to obtain the relative humidity and ambient temperature. Pressure was measured using the ASTM D3631-95 method. Ambient pressure was measured with an aneroid barometer. The thermohygrometer and aneroid barometer were placed in a mechanically aspirated, grey steel box. The accuracy of the thermohygrometer measurements are ±3 percent for relative humidity and ±0.7 °F for ambient temperature based on the manufacturer's performance specifications. The relative humidity is detected using the principle of changes in the capacitance of the sensor as its thin polymer film absorbs water molecules. Temperature is measured with a negative temperature coefficient thermistor. Results of the ambient conditions measurements are shown in Appendix C.

The equipment used to make the ambient conditions measurements is carefully maintained by MRI's Field Measurements section. The instrumentation was calibrated according to MRI standard operating procedures (SOPs): MRI-0721 - *Calibration of Thermocouple Probes, Thermocouple Indicators and Digital Thermometers*, MRI-0722 - *Calibration of Pressure Gauges*, and MRI-0729 - *Qualification and Calibration of Hygrometers* at MRI's laboratory before being transported to the field measurement site. Results of those calibrations are presented in Appendix C.

3.3 Data Acquisition and Data Management

Data to document the process operating conditions of the turbine and Xonon™ system were recorded by the turbine's HMI computer. These data were provided by the facility contact to MRI's Field Team Leader in electronic format after each three-run test series. Process data are shown in Appendix B. Data to document the ambient conditions were recorded manually on the sheets shown in Appendix B. A Labtech Notebook was used to record the concentration signals from the individual analyzers. The Labtech Notebook recorded the analyzer output at 1-s intervals and averaged those signals into 1-min averages. At the conclusion of a test run, the pre- and post-test calibration results were manually transcribed into a Microsoft Excel spreadsheet to calculate drift and system bias. After a series of test runs, the test run values were electronically transferred from the Labtech Notebook into a Microsoft Excel spreadsheet for data calculations and averaging. The calculations done by Microsoft Excel used the default rounding convention. The raw data printouts from the Labtech Notebook and the test run averages are shown in Appendix B.

For Method 20, the first 1-min average, after moving to a new traverse point, is typically disregarded as not representing the concentration at that traverse point. However, for this test program, since gaseous stratification was not present and test runs were 32 min in length, all data were used in the NO_x and O_2 concentration averages.

For this test program, the data measurement and collection activities for the Method 20 measurements shown in Figure 5 were used. This flow chart includes all data activities from the initial pretest QA steps to the passing of the data to the Task Leader. These steps were followed in the field. Data for other methods used during this verification test were collected and handled in the same manner as the Method 20 data.

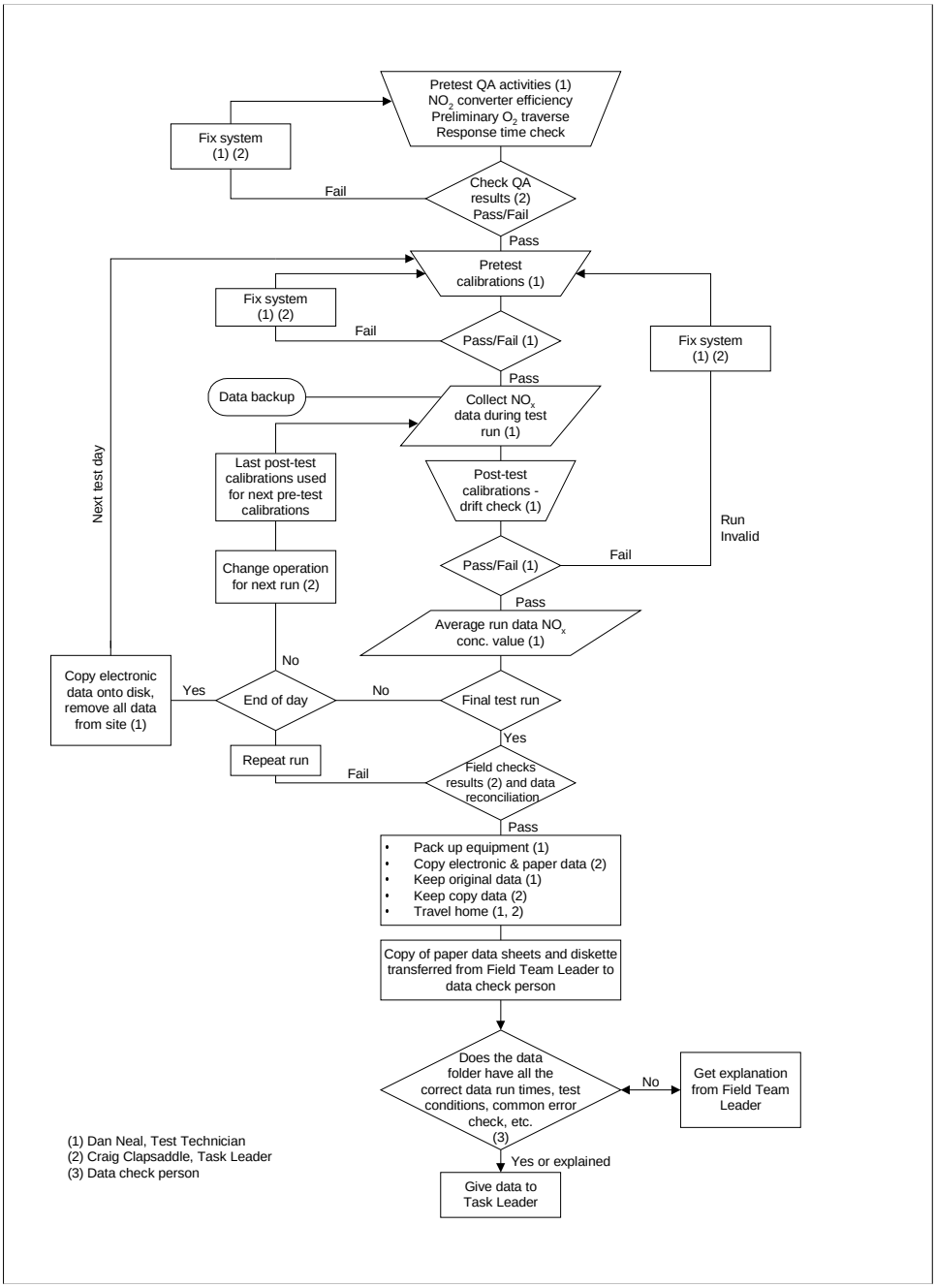


Figure 5. Method 20 NO_x/O_2 gas turbine emissions measurement flowchart.

Section 4.0

Statement of Operating Range of Test

For this verification test of the Xonon™ flameless combustion system, the CCSI representative indicated that the emissions performance of the technology was guaranteed to be less than 2.5 ppmvd NO_x at 15 percent O_2 and to be less than 6 ppmvd CO at 15 percent O_2. Without the air management system, this emission guarantee was valid only at full turbine load conditions. Therefore, the verification test was done at full turbine load.

During consultation with the CCSI representative, the only parameter identified that could possibly have an effect on emissions was ambient temperature. In general, lower ambient temperatures result in slightly higher NO_x emissions for Xonon™ -equipped turbines because slightly more fuel must be used in the pre-burner to achieve the desired inlet temperature to the catalyst. To evaluate the effect of ambient temperature on NO_x emissions, the verification test was conducted during and after sunrise (to achieve the lowest ambient temperature of the day) and during the afternoon (to achieve the highest ambient temperature of the day). The ambient temperature range experienced during the 12 test runs was from 15.1 to 25.3°C (58.8 to 77.2°F).

Data to document the process operating conditions of the turbine and Xonon™ flameless combustion system were recorded by the turbine's HMI computer. The operating conditions during the 12 test runs are presented in Table 7. The bottom two rows of Table 7 show the minimum and maximum values for each parameter. These minimum and maximum values form the operating range over which this verification test was conducted.

The natural gas collected during the test showed that the fuel had a dry gas higher heating value of 3.778×10^7 gross J/m^3 (1012.9 Btu/ft^3). The gas analysis is attached in Appendix B.

Table 7. Operating Parameter Ranges

	Ambient Temp.		Turbine Load		Fuel Flow Rate		Compressor Inlet Temp.		Compressor Discharge Pressure		Compressor Discharge Temp.		Temp. at Catalyst Inlet		Temp. Out of Catalyst		Exhaust Gas Temp.	
Run	°C	°F	(MW)	(%)[a]	kg/h	lb/h	°C	°F	kPa	psig	°C	°F	°C	°F	°C	°F	°C	°F
1	15.2	59	1.39	97.9	428	944	17	62	910	132	356	672	480	895	847	1557	524	980
2	16.3	61	1.38	98.1	425	937	17	63	903	131	356	673	480	895	847	1557	527	981
3	17.4	63	1.37	97.9	423	932	19	65	896	130	357	675	480	896	848	1558	529	983
4	25.2	77	1.25	98.9	406	894	26	78	869	126	364	686	484	903	850	1562	535	994
5	24.1	75	1.27	98.6	405	893	25	77	869	126	364	686	484	903	851	1564	534	993
6	21.3	70	1.29	98.4	411	907	22	72	876	127	361	682	481	898	849	1560	532	989
7	14.6	58	1.36	98.2	428	944	16	60	910	132	355	670	480	896	846	1555	526	979
8	16.3	61	1.35	98.3	425	938	17	63	910	132	356	673	480	896	847	1556	527	981
9	17.4	63	1.33	98.2	423	932	19	65	896	130	357	674	480	896	847	1556	529	983
10	20.7	69	1.29	98.4	412	908	22	72	882	128	361	681	481	898	846	1555	531	988
11	21.9	71	1.25	99.0	408	899	25	76	876	127	362	684	481	898	847	1556	533	991
12	23.5	74	1.23	98.4	407	898	25	76	869	126	362	684	482	900	849	1559	533	991
Minimum	15.2	59	1.23	97.9	405	893	16	60	869	126	355	670	480	895	846	1555	526	979
Maximum	25.2	77	1.39	99.0	425	944	26	78	910	132	364	686	484	903	851	1564	535	994

[a]Note: Turbine load (%) is the percent of turbine capability at the prevailing ambient conditions.

Section 5.0

Summary and Discussion of Results

A verification test of the Xonon™ flameless combustion system was conducted on July 18 and 19, 2000, in Santa Clara, California. The purpose of the verification test was to evaluate the NO_x emission performance for the Xonon™ flameless combustion system as claimed by CCSI. The test was conducted according to a test/QA plan that was approved by EPA on June 28, 2000.

The results of the verification test are summarized in Section 5.1. An important part of the verification test was the extensive QA applied to this field test. The results of all the QA and quality control (QC) checks performed during this verification test are summarized in Section 5.2. A few minor deviations from the test plan were encountered, and those are discussed in Section 5.3.

5.1 Results Supporting Verification Statement

The pollutant emission concentrations measured for the 12 test runs are presented in Table 8. As can be seen, the NO_x emission concentration was below the 2.5 ppmvd at 15 percent O_2 performance claim offered by CCSI. Also, the CO emission concentration is well below 6 ppmvd at 15 percent O_2. In addition, the unburned hydrocarbons concentrations were very low and virtually undetectable during the 12 test runs.

Table 8. Pollutant Emission Concentrations for Xonon™ Verification Test

Run	Ambient Temp. (°F)	NO_x (ppmvd @ 15% O_2)	CO (ppmvd @ 15% O_2)	UHC (as propane) (ppmvw)
1	59	1.15	1.19	0.17
2	61	1.14	1.71	0.16
3	63	1.08	1.50	0.17
4	77	1.06	1.10	0.15
5	75	1.11	1.03	0.17
6	70	1.13	1.22	0.15
7	58	1.22	1.10	0.18
8	61	1.17	1.02	0.13
9	63	1.13	1.19	0.20
10	69	1.14	1.91	0.12
11	71	1.12	1.88	0.18
12	74	1.13	1.46	0.19

5.1.1 Statistical Analysis of Variance

This section describes the statistical analysis of the verification test data. As discussed in Section 3.1, detection of ambient temperature effects required wide swings in daily temperature,

which did not occur during the test period. The measured values from the verification test are compared to the performance capability range specified by CCSI. The first step in the statistical analysis was to perform the analysis of variance of NO_x concentration on ambient temperature. This step determines if ambient temperature has a significant effect on NO_x emissions at the 95 percent confidence level.

The analysis of variance produced a P-value of 0.1647. Only when the P-value is less than 0.05 would the ambient temperature have a significant effect on NO_x at the 95 percent confidence level. Therefore, the turbine's NO_x emissions were not affected by ambient temperature over the range of 58°F to 77°F.

5.1.2 Variability of NO_x Emissions

Because NO_x emissions were not a function of ambient temperature, the 95 percent confidence interval was calculated for the entire 12-run data set. The 95 percent confidence interval was found to be ±0.026 ppmvd at 15 percent O_2. Therefore, the NO_x emission concentration for this verification test can be stated as follows:

1.13 ± 0.026 ppmvd at 15 percent O_2 at the 95 percent confidence level.

5.2 Discussion of QA/QC and QA Statement

Extensive QA/QC was applied to this verification test, much more than is typically applied to an emissions test. The following QA and QC activities were part of this test:

- A DQO for the NO_x concentration measurement,
- Reference method QC checks,
- A technical system audit to evaluate all components of the data gathering and data management system,
- A performance evaluation sample to check the operation of the NO_x measurement system, and
- A data audit of 30 percent of the critical measurement (NOx concentration) and 10 percent of the noncritical measurement.

The results of each of these QA and QC checks are presented in Sections 5.2.1 through 5.2.3.

5.2.1 NO_x Measurement DQO

The DQO for the NO_x emission concentration measurement was stated in the test/QA plan as follows:

> For the NO_x emission concentration measurements, the overall NO_x emission must be within ±10 percent of the mean emission concentration above 5 ppmvd, ±25 percent below 5 and above 2 ppmvd, and ±50 percent below 2 ppmvd.

The DQO was computed as the half-width of the 95 percent confidence interval of the mean divided by the mean. Since ambient temperature was not significant, all 12 test runs were included in the DQO assessment.

As presented in Section 5.1.2, the half-width of the 95 percent confidence interval was 0.026 ppmvd at 15 percent O_2 and the mean NO_x concentration was 1.13 ppmvd at 15 percent O_2. Therefore, the DQO for NO_x equates to 2.3 percent, well within the DQO limit of 50 percent below 2 ppmvd.

5.2.2 Reference Method QC

The reference methods used to measure emission concentrations of NO_x, O_2/CO_2, CO, and UHCs have specific QC criteria that must be met. The QC criteria ensure the accuracy and stability of the measurement system and are summarized in Table 9. The results of the reference method QC checks are summarized in Sections 5.2.2.1 through 5.2.2.7. The raw data for the QC checks are in Appendix A.

Table 9. Reference Method QC Criteria

Method	Check	Criteria
Method 205	Dilution error	± 2% of reference value
Method 20	Interference	≤ 2% of span
	NO_2 converter efficiency	98%
	Response time	< 30 s
	Calibration error	± 2% of span
	Drift	± 2% of span
Method 10	Calibration error	± 2% of span
	System bias	± 5% of span
	Drift	± 3% of span
Method 25A	Calibration error	± 5% of gas value
	Drift	± 3% of span
Method 1	Traverse point	± 1 inch

5.2.2.1 Method 205 Dilution System Verification—

A gas dilution system was used to generate the targeted calibration gas concentrations from single, high-concentration EPA protocol gases specific to each analyzer. This dilution system must be verified in the field before each test program according to EPA Method 205 procedures. The dilution system verification was done with the NO_x analyzer on a 0- to 50-ppmv measurement range. The results of the verification of MFCs 1 and 2 and 1 and 3 are presented in Tables 10 and 11, respectively. For acceptable performance, the three-injection average at the low and high dilution points and

Table 10. Method 205 Summary Data Verification of Mass Flow Controllers 1 and 2

Standard Calibration Points	Reference Value Concentration (ppmv)	Average Analyzer Reading (ppmv)	Error (%)
Low dilution	24.90	24.64	1.03
Mid-level supply	25.59	25.46	0.52
Upper dilution	44.90	45.08	-0.40

the mid-level supply gas must be within ±2 percent of the reference value. As indicated in Tables 10 and 11, all dilution points were within the required ±2 percent.

Table 11. Method 205 Summary Data Verification of Mass Flow Controllers 1 and 3

Standard Calibration Points	Reference Value Concentration (ppmv)	Average Analyzer Reading (ppmv)	Error (%)
Low dilution	25.07	24.64	1.73
Mid-level supply	25.59	25.29	1.18
Upper dilution	45.10	44.87	0.51

5.2.2.2 Interference Test—

Before an analyzer is used, it must be demonstrated that other gases in the effluent do not interfere with the measurement technique. This test was done for the NO_x, CO, O_2, and CO_2 analyzers as required by the reference method. For acceptable performance the total interference from all the gases injected must be ±2 percent or less. The interference results are presented in Table 12. Those results show that none of the analyzers exhibited unacceptable interference.

5.2.2.3 NO_2 Converter Efficiency Test—

Before each test program, the NO_x analyzer must demonstrate that the NO_2 converter is at least 98 percent efficient. The performance criteria state that, during the 30-min NO_2 converter efficiency test, the last NO_x analyzer reading must not decrease by more than 2 percent from the highest reading. The NO_2 converter showed a 0.2 percent decrease (5.02 ppmv was the highest reading and 5.01 ppmv was the last reading), well within the criteria for an acceptable converter. During the entire NO_2 converter efficiency test, the readings ranged from 4.97 to 5.02 ppmv.

Table 12. Analyzer Interference Results

Analyzer	Interference (% span)
NO_x	-0.25
CO	-1.80
O_2	0.80
CO_2	1.50

5.2.2.4 Response Time Test—

A response time test was done for NO_x, O_2, CO_2, and UHCs. Method 20 requires a response time of 30 s or less. The results of the response time tests are summarized in Table 13.

Table 13. Response Times (seconds)

NO_x	O_2	CO_2	UHCs
27	25	24	19

5.2.2.5 Method 20 Calibrations—

For Method 20, the two calibration criteria are calibration error (±2 percent of span) and drift (±2 percent of span). The largest calibration error and drift for the NO_x, O_2, and CO_2 analyzers are presented in Table 14. See Appendix A, Pre- and Post-test Calibration Results. As shown in Table 14, all calibration criteria were met.

5.2.2.6 Method 10 Calibrations—

For Method 10 as performed for this test, the three calibration criteria are calibration error (±2 percent of span), system bias (±5 percent of span), and drift (±3 percent of span). The largest absolute calibration error was 0.46 percent, the largest system bias was -1.28 percent, and the largest drift was -0.44 percent. See Appendix A, Pre- and Post-Test Calibration Results. All calibration criteria were met.

Table 14. Method 20 Calibration Error and Drift Results

	Largest Absolute Calibration Error (%)	Largest Drift (%)
NO_x	-0.55	1.15
O_2	0.46	0.32
CO_2	0.43	1.20

5.2.2.7 Method 25A Calibrations—

For Method 25A, the two calibration criteria are calibration error (±5 percent of the gas value) and drift (±3 percent of span). The largest calibration error was -0.39 percent and the largest drift was -0.42 percent. See Appendix A, Pre- and Post-test Calibration Results. All calibration criteria were met.

5.2.3 Audits

Independent systematic checks to determine the quality of the data were performed throughout this project. These checks consisted of a technical system audit, a performance evaluation audit, and a data audit as described in Sections 5.2.3.1 through 5.2.3.3. The combination of these three audits and the evaluation of the method's QC data allowed the assessment of the overall quality of the data for this project. MRI's Task Leader managed the collection of and reviewed the field data as detailed in Sections B10.1, C1.1, and C1.2 of the test/QA plan.

5.2.3.1 Technical System Audit—

The technical system audit (TSA) was conducted by Robert Wright, RTI Quality Manager, and Michael Tufts of ARCADIS Geraghty and Miller, an EPA contractor. This audit evaluated all components of the data gathering and management system to determine if these systems had been properly designed to meet the QA objectives for this study. The TSA included a careful review of the experimental design, the test plan, and procedures. This review included personnel qualifications, adequacy and safety of the facilities and equipment, standard operating procedures (SOPs), and the data management system.

The TSA began with the review of study requirements, procedures, and experimental design to ensure that they met the data quality objectives for the study. During the system audit, the Task QA Officer inspected the analytical activities and determined their adherence to the SOPs and the test/QA plan.

The draft summary of Wright's TSA is provided in Appendix A. In general, the TSA found that the test program, as conducted, met all the data quality objectives for the study.

5.2.3.2 Performance Evaluation Audit—

A performance evaluation (PE) audit was conducted by Mike Tufts for EPA. For the PE audit, a performance evaluation sample (PES) was supplied to check the operation of the NO_x analytical system. The PES was measured for 6 continuous minutes on two occasions for a total of 12 measurements. The NO_x measurement systems read the 1.00 ppmv NO_x PES as 0.991 ± 0.012 ppmv at the 95 percent confidence level. A summary of the performance evaluation audit is presented in Table 15.

Table 15. NO_x Analyzer Performance Evaluation Audit

Time	NO_x System Readings (ppmv)
10:27	1.02
10:28	1.02
10:29	0.99
10:30	0.99
10:31	0.98
10:32	0.98
16:29	1.01
16:30	1.00
16:31	0.99
16:32	0.98
16:33	0.97
16:34	0.96
Mean	0.9908
Confidence Interval (95 percent)	0.0119

The method performance also was assessed using the method QC samples described in Sections 5.2.2.1 through 5.2.2.7.

5.2.3.3 Data Audit—

The data audit, an important component of a total system audit, was completed to determine if systematic errors were introduced. The data audit was performed by Jack Balsinger, the MRI task QA officer, by randomly selecting approximately 30 percent of the NO_x data and 10 percent of the remaining data and following them through the calculations. The scope of the data audit was to verify that the data-handling system was correct and to assess the quality of the data generated. The data review and data audit were conducted in accordance with MRI standard procedures.

In addition to the data audit, a data check was performed by James Surman of MRI. The data check was conducted to find errors in transposing data from the raw data printouts to the calculation sheets in the Microsoft Excel spreadsheets. Data were reviewed for completeness, and the method QC results were checked for acceptability. The Microsoft Excel spreadsheets were checked for accuracy relative to the reference method requirements, and simulated data were used to check the accuracy of the computations. Three minor errors were found and corrected. Two errors were typographical, and one error was a spreadsheet format error.

5.3 Deviations from Test Plan

One deviation from the test plan was experienced during the field test, and one corrective action was taken.

The test/QA plan indicated that an eight-point traverse—four points on one diagonal traverse and four points on another diagonal traverse—was to be done during the Method 20 sampling.

However, because of the arrangement of the scaffolding, only one of the sampling ports could be reached safely. Therefore, only four traverse points on the one diagonal traverse were used. Each point was sampled for 4 minutes during two passes to maintain the 32-min test duration.

While attempting to perform the Method 205 validation test on the dilution system, the NO_x analyzer's output was nonlinear. This issue was resolved by making an adjustment to the analyzer's photomultiplier tube in accordance with the operator's manual. Once the adjustment was made, the analyzer response was linear across the measurement range.

In addition, the auditors noted that the test/QA plan (RTI, 2000b) incorrectly stated that the CO_2 calibration gas consisted of CO_2 in air. It was actually CO_2 in nitrogen.

Section 6.0

References

American Society for Testing and Materials (ASTM). (1996). E337-84(1996)e1. Standard Test Method for Measuring Humidity with a Psychrometer (The Measurement of Wet- and Dry-Bulb Temperatures). American Society for Testing and Materials, West Conshohocken, PA.

American Society for Testing and Materials (ASTM). (1995). D3631-95. Standard Test Method for Measuring Surface Atmospheric Pressure. American Society for Testing and Materials, West Conshohocken, PA.

Research Triangle Institute (RTI). (2000a, August). Environmental Technology Verification Protocol, NO_x Control Technologies for Stationary Combustion Sources (http://etv.rti.org/apct/pdf/NOxVerifProtocol.pdf). Research Triangle Park, NC.

Research Triangle Institute (RTI). (2000b, July). Test/QA Plan for the Verification Testing of Catalytica Combustion Systems, Inc., XONON Flameless Combustion System, Rev. 1. (http://etv.rti.org/apct/pdf/XononTestQAPlanFinal.pdf). Research Triangle Park, NC.

Templeman, B. D. (1995, March). *EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV: Meteorological Measurements*. EPA-600/R-95-050 (NTIS PB95-199782). U.S. Environmental Protection Agency, Atmospheric Research and Exposure Assessment Laboratory, Research Triangle Park, NC.

U.S. Environmental Protection Agency (EPA). (1999). Appendix A - Test Methods to National Emission Standards for New Stationary Sources. Code of Federal Regulations, Title 40, Part 60 (40 CFR Ch. 1 [7-1-99 Edition] Pt. 60, App. A), http://www.epa.gov/epacfr40/chapt-I.info/subch-C/40P0060/40P060XA.pdf.

APPENDIX A

QA/QC Activities and Results

A.1 Pre- and Post-test Calibration Results

A.2 Reference Method Performance Audit Results

A.3 Letter Summarizing Results of Technical System Audit and Performance Evaluation

A.1 Pre- and Post-test Calibration Results

NO_X Measurement System Calibration Data By Method 20

Job No. 101494.1.004.02
Client: CCSI
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Operator: Daniel Neal
Date: 18-Jul-00

Analyzer Type: Chemiluminescent
Analyzer Span: 20 ppmv NO_X
Zero Gas: Prepurified nitrogen
High-level Gas: Nitrogen oxide in nitrogen
Mid-level Gas: Nitrogen oxide in nitrogen
Low-level Gas: Nitrogen oxide in nitrogen

Analyzer Mfgr.: Thermo Environmental Instr.
Model No. 42H
Serial No. 42H-41111-264

System Calibration Check Data

Run No. 1 Load Condition: 100

Run Time:	Start	End
	7:00	7:32

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, ppmv NO_X	Cylinder ID Number	Analyzer Response Value, ppmv NO_X: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
5:11	Zero Gas	0.00	N/A	-0.03	0.04		0.35%	Pass
5:53	High-level	17.04	ALM048090	17.14		Pass		
5:50	Mid-level	10.03	ALM048090	10.03	10.03		0.00%	Pass
5:58	Low-level	5.02	ALM048090	4.94		Pass		

Predicted value from linear curve, ppmv NO_X: High-level: 17.06 Low-level: 5.01
Difference as % of Span: High-level: 0.40% Low-level: -0.33%

a. Responses before run must agree with predicted value on linear curve within 2% of the span value.
b. Drift check must not exceed ±2% of the span value.

$$\text{Percent Drift} = \frac{\text{Absolute difference}}{\text{Span}} \times 100$$

Response Time Determination

Reading	Downscale Response, seconds		Upscale Response, seconds	
1	26		24	
2	29		24	
3	26	Average: 27	25	Average: 24

System Response Time (slower average time) = 27 seconds

System Calibration Check Data (continued)

Run No. 2 Load Condition: 100

Run Time:	Start	End
	8:10	8:42

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, ppmv NO_X	Cylinder ID Number	Analyzer Response Value, ppmv NO_X: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
8:48	Zero Gas	0.00	N/A	0.04	0.04		0.00%	Pass
	High-level	N/A	N/A	N/A		N/A		
9:01	Mid-level	10.03	ALM048090	10.03	9.92		-0.55%	Pass
	Low-level	N/A	N/A	N/A		N/A		

Predicted value from linear curve, ppmv NO_X: High-level: N/A Low-level: N/A
Difference as % of Span: High-level: N/A Low-level: N/A

Run No. 3 Load Condition: 100 Run Time: 9:20 9:52

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, ppmv NO_X	Cylinder ID Number	Analyzer Response Value, ppmv NO_X: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
9:55	Zero Gas	0.00	N/A	0.04	0.04		0.00%	Pass
	High-level	N/A	N/A	N/A		N/A		
10:07	Mid-level	10.03	ALM048090	9.92	9.86		-0.30%	Pass
	Low-level	N/A	N/A	N/A		N/A		

Predicted value from linear curve, ppmv NO_X: High-level: N/A Low-level: N/A
Difference as % of Span: High-level: N/A Low-level: N/A

NO_X Measurement System Calibration Data By Method 20

Job No. 101494.1.004.02
Client: CCSI
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Operator: Daniel Neal
Date: 18-Jul-00

Analyzer Type: Chemiluminescent
Analyzer Span: 20 ppmv NO_X
Zero Gas: Prepurified nitrogen
High-level Gas: Nitrogen oxide in nitrogen
Mid-level Gas: Nitrogen oxide in nitrogen
Low-level Gas: Nitrogen oxide in nitrogen

Analyzer Mfgr.: Thermo Environmental Instr.
Model No. 42H
Serial No. 42H-41111-264

System Calibration Check Data

Run No. 4 — Load Condition: 100 — Run Time: Start 16:40, End 17:12

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Calibration Gas: Value, ppmv NO_X	Calibration Gas: Cylinder ID Number	Analyzer Response Value, ppmv NO_X: Before Run	Analyzer Response Value, ppmv NO_X: After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
15:20	Zero Gas	0.00	N/A	0.02	0.03		0.05%	Pass
15:50	High-level	17.04	ALM048090	16.93		Pass		
15:46	Mid-level	10.03	ALM048090	9.94	9.91		-0.15%	Pass
15:53	Low-level	5.02	ALM048090	4.92		Pass		

Predicted value from linear curve, ppmv NO_X: High-level: 16.87 Low-level: 4.98
Difference as % of Span: High-level: 0.28% Low-level: -0.32%

a. Responses before run must agree with predicted value on linear curve within 2% of the span value.
b. Drift check must not exceed ±2% of the span value.

$$\text{Percent Drift} = \frac{\text{Absolute difference}}{\text{Span}} \times 100$$

Response Time Determination

Reading	Downscale Response, seconds			Upscale Response, seconds		
1	N/A			N/A		
2	N/A			N/A		
3	N/A	Average:	N/A	N/A	Average:	N/A

System Response Time (slower average time) = N/A seconds

System Calibration Check Data (continued)

Run No. 5 — Load Condition: 100 — Run Time: Start 17:50, End 18:22

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Calibration Gas: Value, ppmv NO_X	Calibration Gas: Cylinder ID Number	Analyzer Response Value, ppmv NO_X: Before Run	Analyzer Response Value, ppmv NO_X: After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
18:28	Zero Gas	0.00	N/A	0.03	0.03		0.00%	Pass
	High-level	N/A	N/A	N/A		N/A		
18:41	Mid-level	10.03	ALM048090	9.91	9.93		0.10%	Pass
	Low-level	N/A	N/A	N/A		N/A		

Predicted value from linear curve, ppmv NO_X: High-level: N/A Low-level: N/A
Difference as % of Span: High-level: N/A Low-level: N/A

Run No. 6 — Load Condition: 100 — Run Time: 18:58, 19:30

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Calibration Gas: Value, ppmv NO_X	Calibration Gas: Cylinder ID Number	Analyzer Response Value, ppmv NO_X: Before Run	Analyzer Response Value, ppmv NO_X: After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
19:35	Zero Gas	0.00	N/A	0.03	0.03		0.00%	Pass
	High-level	N/A	N/A	N/A		N/A		
19:47	Mid-level	10.03	ALM048090	9.93	9.90		-0.15%	Pass
	Low-level	N/A	N/A	N/A		N/A		

Predicted value from linear curve, ppmv NO_X: High-level: N/A Low-level: N/A
Difference as % of Span: High-level: N/A Low-level: N/A

NO_X Measurement System Calibration Data By Method 20

Job No. 101494.1.004.02 | Operator: Daniel Neal
Client: CCSI | Date: 19-Jul-00
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Analyzer Type: Chemiluminescent | Analyzer Mfgr.: Thermo Environmental Instr.
Analyzer Span: 20 ppmv NO_X | Model No. 42H
Zero Gas: Prepurified nitrogen | Serial No. 42H-41111-264
High-level Gas: Nitrogen oxide in nitrogen
Mid-level Gas: Nitrogen oxide in nitrogen
Low-level Gas: Nitrogen oxide in nitrogen

System Calibration Check Data

Run No. 7 | Load Condition: 100 | Run Time: Start 6:40 | End 7:12

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, ppmv NO_X	Cylinder ID Number	Analyzer Response Value, ppmv NO_X: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
4:41	Zero Gas	0.00	N/A	0.00	0.02		0.10%	Pass
5:56	High-level	17.04	ALM048090	16.80		Pass		
5:53	Mid-level	10.03	ALM048090	9.95	9.74		-1.05%	Pass
6:00	Low-level	5.02	ALM048090	4.87		Pass		

Predicted value from linear curve, ppmv NO_X: High-level: 16.90 Low-level: 4.98
Difference as % of Span: High-level: -0.52% Low-level: -0.55%

a. Responses before run must agree with predicted value on linear curve within 2% of the span value.
b. Drift check must not exceed ±2% of the span value.

$$\text{Percent Drift} = \frac{\text{Absolute difference}}{\text{Span}} \times 100$$

Response Time Determination

Reading	Downscale Response, seconds			Upscale Response, seconds		
1	N/A			N/A		
2	N/A			N/A		
3	N/A	Average:	N/A	N/A	Average:	N/A
System Response Time (slower average time) =			N/A			seconds

System Calibration Check Data (continued)

Run No. 8 | Load Condition: 100 | Run Time: Start 7:45 | End 8:17

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, ppmv NO_X	Cylinder ID Number	Analyzer Response Value, ppmv NO_X: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
8:21	Zero Gas	0.00	N/A	0.02	0.03		0.05%	Pass
	High-level	N/A	N/A	N/A		N/A		
8:33	Mid-level	10.03	ALM048090	9.74	9.58		-0.80%	Pass
	Low-level	N/A	N/A	N/A		N/A		

Predicted value from linear curve, ppmv NO_X: High-level: N/A Low-level: N/A
Difference as % of Span: High-level: N/A Low-level: N/A

Run No. 9 | Load Condition: 100 | Run Time: 8:50 | 9:22

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, ppmv NO_X	Cylinder ID Number	Analyzer Response Value, ppmv NO_X: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
9:30	Zero Gas	0.00	N/A	0.03	0.03		0.00%	Pass
	High-level	N/A	N/A	N/A		N/A		
9:43	Mid-level	10.03	ALM048090	9.58	9.55		-0.15%	Pass
	Low-level	N/A	N/A	N/A		N/A		

Predicted value from linear curve, ppmv NO_X: High-level: N/A Low-level: N/A
Difference as % of Span: High-level: N/A Low-level: N/A

NO_X Measurement System Calibration Data By Method 20

Job No. 101494.1.004.02 Operator: Daniel Neal
Client: CCSI Date: 19-Jul-00
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

System Calibration Check Data (continued)

Run No. 10 — **Load Condition: 100** — Run Time: Start 11:20, End 11:52

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, ppmv NO_X	Cylinder ID Number	Analyzer Response Value, ppmv NO_X: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
11:58	Zero Gas	0.00	N/A	0.03	0.02		-0.05%	Pass
	High-level	N/A	N/A	N/A		N/A		
12:09	Mid-level	10.03	ALM048090	9.55	9.78		1.15%	Pass
	Low-level	N/A	N/A	N/A		N/A		

Predicted value from linear curve, ppmv NO_X: High-level: N/A Low-level: N/A
Difference as % of Span: High-level: N/A Low-level: N/A

Run No. 11 — **Load Condition: 100** — Run Time: 12:30, 13:02

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, ppmv NO_X	Cylinder ID Number	Analyzer Response Value, ppmv NO_X: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
13:10	Zero Gas	0.00	N/A	0.02	0.00		-0.10%	Pass
	High-level	N/A	N/A	N/A		N/A		
13:21	Mid-level	10.03	ALM048090	9.78	9.78		0.00%	Pass
	Low-level	N/A	N/A	N/A		N/A		

Predicted value from linear curve, ppmv NO_X: High-level: N/A Low-level: N/A
Difference as % of Span: High-level: N/A Low-level: N/A

Run No. 12 — **Load Condition: 100** — Run Time: 13:36, 14:08

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, ppmv NO_X	Cylinder ID Number	Analyzer Response Value, ppmv NO_X: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
14:12	Zero Gas	0.00	N/A	0.00	0.02		0.10%	Pass
	High-level	N/A	N/A	N/A		N/A		
14:25	Mid-level	10.03	ALM048090	9.78	9.77		-0.05%	Pass
	Low-level	N/A	N/A	N/A		N/A		

Predicted value from linear curve, ppmv NO_X: High-level: N/A Low-level: N/A
Difference as % of Span: High-level: N/A Low-level: N/A

CO Measurement System Calibration Data (Method 10 & Method 6C)

Job No. 101494.1.004.02 | Operator: Daniel Neal
Client: CCSI | Date: 18-Jul-00
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Analyzer Type: NDIRS with GFC | Analyzer Mfgr.: Thermo Environmental Instr.
Analyzer Span: 50 ppmv CO | Model No. 48
Zero Gas: Prepurified nitrogen | Serial No. 48-29095-233
Cal. Gas Mixture: Carbon monoxide in nitrogen

Analyzer Calibration Error and Linearity Determination

Run Time: Start 7:00 – End 7:32

Run No. 1 — Load Condition: 100

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv CO	Calibration Gas Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv CO	Response Difference, % of Span	Cal. Error Check Result[a]	Linearity Check Result[b]
4:50	Zero Gas	0.00	N/A	0.07	0.14%	Pass	
4:58	High-range	44.90	AAL17607	45.13	0.46%	Pass	
5:01	Mid-range	29.90	AAL17607	30.03	0.26%	Pass	Pass
5:04	Low-range	15.00	AAL17607	15.01	0.02%	Pass	Pass

Predicted value from linear curve, ppmv CO		Difference as % of Span	
Range: Mid = 30.08	Low = 15.12	Mid = -0.09%	Low = -0.23%

a. Calibration error check must not exceed ±2% of the span value.

b. Responses before run must agree with predicted value on linear curve within 2% of the span value.

Measurement System Calibration Bias, Response Time, and Drift

Initial Bias and Response Time Determinations

Calibration Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv CO	System Response, ppmv CO	Response Time[c], seconds	System Cal. Bias, % of Span	Bias Check Result[d]
5:13	Zero Gas	0.07	0.03	62	-0.08%	Pass
6:01	Mid-range	30.03	29.79	56	-0.48%	Pass

Final Bias and Drift Determinations

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result[d]	Drift, % of Span	Drift Check Result[e]
7:37	Zero Gas	0.00	-0.14%	Pass	-0.06%	Pass
7:54	Mid-range	29.57	-0.92%	Pass	-0.44%	Pass

c. Response time check according to Method 6C. The longer time is used.

d. System bias check must not exceed ±5% of the span value.

e. Drift check must not exceed ±3% of the span value.

$$\text{System Calibration Bias} = \frac{\text{System Cal. Response - Analyzer Cal. Response}}{\text{Span}} \times 100$$

$$\text{Drift} = \frac{\text{Final System Cal. Response - Initial System Cal. Response}}{\text{Span}} \times 100$$

CO Measurement System Calibration Data (Method 10 & Method 6C)

Job No. 101494.1.004.02 Operator: Daniel Neal

Client: CCSI Date: 18-Jul-00

Plant: Gianera Generating Station

Location: Gas Turbine Outlet

Analyzer Calibration Error and Linearity Determination

Run Time: Start 8:10 End 8:42

Run No. 2 Load Condition: 100

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv CO	Calibration Gas Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv CO	Response Difference, % of Span	Cal. Error Check Result	Linearity Check Result
4:50	Zero Gas	0.00	N/A	0.07	0.14%	Pass	
4:58	High-range	44.90	AAL17607	45.13	0.46%	Pass	
5:01	Mid-range	29.90	AAL17607	30.03	0.26%	Pass	Pass
5:04	Low-range	15.00	AAL17607	15.01	0.02%	Pass	Pass

Predicted value from linear curve, ppmv CO — Range: Mid = 30.08 Low = 15.12

Difference as % of Span — Mid = -0.09% Low = -0.23%

Measurement System Calibration Bias and Drift

Initial Bias Determination

Calibration Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv CO	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result
7:37	Zero Gas	0.07	0.00	-0.14%	Pass
7:54	Mid-range	30.03	29.57	-0.92%	Pass

Final Bias and Drift Determinations

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result	Drift, % of Span	Drift Check Result
8:48	Zero Gas	0.00	-0.14%	Pass	0.00%	Pass
9:06	Mid-range	29.55	-0.96%	Pass	-0.04%	Pass

Analyzer Calibration Error and Linearity Determination

Run Time: Start 9:20 End 9:52

Run No. 3 Load Condition: 100

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv CO	Calibration Gas Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv CO	Response Difference, % of Span	Cal. Error Check Result	Linearity Check Result
4:50	Zero Gas	0.00	N/A	0.07	0.14%	Pass	
4:58	High-range	44.90	AAL17607	45.13	0.46%	Pass	
5:01	Mid-range	29.90	AAL17607	30.03	0.26%	Pass	Pass
5:04	Low-range	15.00	AAL17607	15.01	0.02%	Pass	Pass

Predicted value from linear curve, ppmv CO — Range: Mid = 30.08 Low = 15.12

Difference as % of Span — Mid = -0.09% Low = -0.23%

Measurement System Calibration Bias and Drift

Initial Bias Determination

Calibration Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv CO	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result
8:48	Zero Gas	0.07	0.00	-0.14%	Pass
9:06	Mid-range	30.03	29.55	-0.96%	Pass

Final Bias and Drift Determinations

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result	Drift, % of Span	Drift Check Result
9:56	Zero Gas	-0.07	-0.28%	Pass	-0.14%	Pass
10:10	Mid-range	29.39	-1.28%	Pass	-0.32%	Pass

CO Measurement System Calibration Data (Method 10 & Method 6C)

Job No. 101494.1.004.02 Operator: Daniel Neal

Client: CCSI Date: 18-Jul-00

Plant: Gianera Generating Station

Location: Gas Turbine Outlet

Analyzer Type: NDIRS with GFC Analyzer Mfgr.: Thermo Environmental Instr.

Analyzer Span: 50 ppmv CO Model No. 48

Zero Gas: Prepurified nitrogen Serial No. 48-29095-233

Cal. Gas Mixture: Carbon monoxide in nitrogen

Analyzer Calibration Error and Linearity Determination

Run No. 4 Load Condition: 100

Run Time: Start 16:40 End 17:12

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv CO	Calibration Gas Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv CO	Response Difference, % of Span	Cal. Error Check Result[a]	Linearity Check Result[b]
15:01	Zero Gas	0.00	N/A	-0.07	-0.14%	Pass	
15:06	High-range	44.90	AAL17607	44.98	0.16%	Pass	
15:10	Mid-range	29.90	AAL17607	30.01	0.22%	Pass	Pass
15:14	Low-range	15.04	AAL17607	14.90	-0.28%	Pass	Pass

Predicted value from linear curve, ppmv CO		Difference as % of Span	
Range: Mid = 29.93	Low = 15.02	Mid = 0.16%	Low = -0.24%

a. Calibration error check must not exceed ±2% of the span value.

b. Responses before run must agree with predicted value on linear curve within 2% of the span value.

Measurement System Calibration Bias, Response Time, and Drift

Initial Bias and Response Time Determinations

Calibration Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv CO	System Response, ppmv CO	Response Time[c], seconds	System Cal. Bias, % of Span	Bias Check Result[d]
15:58	Zero Gas	-0.07	0.09	56	0.32%	Pass
16:05	Mid-range	30.01	29.95	57	-0.12%	Pass

Final Bias and Drift Determinations

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result[d]	Drift, % of Span	Drift Check Result[e]
17:19	Zero Gas	0.00	0.14%	Pass	-0.18%	Pass
17:37	Mid-range	29.88	-0.26%	Pass	-0.14%	Pass

c. Response time check according to Method 6C. The longer time is used.

d. System bias check must not exceed ±5% of the span value.

e. Drift check must not exceed ±3% of the span value.

$$\text{System Calibration Bias} = \frac{\text{System Cal. Response - Analyzer Cal. Response}}{\text{Span}} \times 100$$

$$\text{Drift} = \frac{\text{Final System Cal. Response - Initial System Cal. Response}}{\text{Span}} \times 100$$

CO Measurement System Calibration Data (Method 10 & Method 6C)

Job No. 101494.1.004.02 Operator: Daniel Neal

Client: CCSI Date: 18-Jul-00

Plant: Gianera Generating Station

Location: Gas Turbine Outlet

Analyzer Calibration Error and Linearity Determination

Run Time: Start 17:50 End 18:22

Run No. 5 Load Condition: 100

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv CO	Calibration Gas Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv CO	Response Difference, % of Span	Cal. Error Check Result	Linearity Check Result
15:01	Zero Gas	0.00	N/A	-0.07	-0.14%	Pass	
15:06	High-range	44.90	AAL17607	44.98	0.16%	Pass	
15:10	Mid-range	29.90	AAL17607	30.01	0.22%	Pass	Pass
15:14	Low-range	15.04	AAL17607	14.90	-0.28%	Pass	Pass

Predicted value from linear curve, ppmv CO — Range: Mid = 29.93 Low = 15.02

Difference as % of Span — Mid = 0.16% Low = -0.24%

Measurement System Calibration Bias and Drift

Initial Bias Determination

Calibration Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv CO	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result
17:19	Zero Gas	-0.07	0.00	0.14%	Pass
17:37	Mid-range	30.01	29.88	-0.26%	Pass

Final Bias and Drift Determinations

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result	Drift, % of Span	Drift Check Result
18:29	Zero Gas	0.02	0.18%	Pass	0.04%	Pass
18:45	Mid-range	29.81	-0.40%	Pass	-0.14%	Pass

Analyzer Calibration Error and Linearity Determination

Run Time: Start 18:58 End 19:30

Run No. 6 Load Condition: 100

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv CO	Calibration Gas Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv CO	Response Difference, % of Span	Cal. Error Check Result	Linearity Check Result
15:01	Zero Gas	0.00	N/A	-0.07	-0.14%	Pass	
15:06	High-range	44.90	AAL17607	44.98	0.16%	Pass	
15:10	Mid-range	29.90	AAL17607	30.01	0.22%	Pass	Pass
15:14	Low-range	15.04	AAL17607	14.90	-0.28%	Pass	Pass

Predicted value from linear curve, ppmv CO — Range: Mid = 29.93 Low = 15.02

Difference as % of Span — Mid = 0.16% Low = -0.24%

Measurement System Calibration Bias and Drift

Initial Bias Determination

Calibration Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv CO	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result
18:29	Zero Gas	-0.07	0.02	0.18%	Pass
18:45	Mid-range	30.01	29.81	-0.40%	Pass

Final Bias and Drift Determinations

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result	Drift, % of Span	Drift Check Result
19:36	Zero Gas	0.10	0.34%	Pass	0.16%	Pass
19:52	Mid-range	29.86	-0.30%	Pass	0.10%	Pass

CO Measurement System Calibration Data (Method 10 & Method 6C)

Job No. 101494.1.004.02 | Operator: Daniel Neal
Client: CCSI | Date: 19-Jul-00
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Analyzer Type: NDIRS with GFC | Analyzer Mfgr.: Thermo Environmental Instr.
Analyzer Span: 50 ppmv CO | Model No. 48
Zero Gas: Prepurified nitrogen | Serial No. 48-29095-233
Cal. Gas Mixture: Carbon monoxide in nitrogen

Analyzer Calibration Error and Linearity Determination

Run No. 7 | Load Condition: 100 | Run Time: Start 6:40 | End 7:12

Calibration Ending Time	Calibration Gas: Concentration Level	Calibration Gas: Value, ppmv CO	Calibration Gas: Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv CO	Response Difference, % of Span	Cal. Error Check Result[a]	Linearity Check Result[b]
4:25	Zero Gas	0.00	N/A	-0.07	-0.14%	Pass	
4:28	High-range	44.90	AAL17607	45.04	0.28%	Pass	
4:31	Mid-range	29.90	AAL17607	30.12	0.44%	Pass	Pass
4:35	Low-range	15.04	AAL17607	14.98	-0.12%	Pass	Pass

Predicted value from linear curve, ppmv CO: Range: Mid = 29.97 Low = 15.04
Difference as % of Span: Mid = 0.30% Low = -0.12%

a. Calibration error check must not exceed ±2% of the span value.

b. Responses before run must agree with predicted value on linear curve within 2% of the span value.

Measurement System Calibration Bias, Response Time, and Drift

Initial Bias and Response Time Determinations

Calibration Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv CO	System Response, ppmv CO	Response Time[c], seconds	System Cal. Bias, % of Span	Bias Check Result[d]
6:02	Zero Gas	-0.07	-0.03	60	0.08%	Pass
6:05	Mid-range	30.12	29.83	56	-0.58%	Pass

Final Bias and Drift Determinations

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result[d]	Drift, % of Span	Drift Check Result[e]
7:17	Zero Gas	0.01	0.16%	Pass	0.08%	Pass
7:32	Mid-range	29.85	-0.54%	Pass	0.04%	Pass

c. Response time check according to Method 6C. The longer time is used.

d. System bias check must not exceed ±5% of the span value.

e. Drift check must not exceed ±3% of the span value.

$$\text{System Calibration Bias} = \frac{\text{System Cal. Response - Analyzer Cal. Response}}{\text{Span}} \times 100$$

$$\text{Drift} = \frac{\text{Final System Cal. Response - Initial System Cal. Response}}{\text{Span}} \times 100$$

CO Measurement System Calibration Data (Method 10 & Method 6C)

Job No. 101494.1.004.02 Operator: Daniel Neal
Client: CCSI Date: 19-Jul-00
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Analyzer Calibration Error and Linearity Determination

Run No. 8 Load Condition: 100 Run Time: Start 7:45 End 8:17

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv CO	Calibration Gas Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv CO	Response Difference, % of Span	Cal. Error Check Result	Linearity Check Result
4:25	Zero Gas	0.00	N/A	-0.07	-0.14%	Pass	
4:28	High-range	44.90	AAL17607	45.04	0.28%	Pass	
4:31	Mid-range	29.90	AAL17607	30.12	0.44%	Pass	Pass
4:35	Low-range	15.04	AAL17607	14.98	-0.12%	Pass	Pass

Predicted value from linear curve, ppmv CO: Range: Mid = 29.97 Low = 15.04
Difference as % of Span: Mid = 0.30% Low = -0.12%

Measurement System Calibration Bias and Drift

Initial Bias Determination

Calibration Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv CO	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result
7:17	Zero Gas	-0.07	0.01	0.16%	Pass
7:32	Mid-range	30.12	29.85	-0.54%	Pass

Final Bias and Drift Determinations

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result	Drift, % of Span	Drift Check Result
8:21	Zero Gas	0.02	0.18%	Pass	0.02%	Pass
8:37	Mid-range	29.67	-0.90%	Pass	-0.36%	Pass

Analyzer Calibration Error and Linearity Determination

Run No. 9 Load Condition: 100 Run Time: Start 8:50 End 9:22

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv CO	Calibration Gas Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv CO	Response Difference, % of Span	Cal. Error Check Result	Linearity Check Result
4:25	Zero Gas	0.00	N/A	-0.07	-0.14%	Pass	
4:28	High-range	44.90	AAL17607	45.04	0.28%	Pass	
4:31	Mid-range	29.90	AAL17607	30.12	0.44%	Pass	Pass
4:35	Low-range	15.04	AAL17607	14.98	-0.12%	Pass	Pass

Predicted value from linear curve, ppmv CO: Range: Mid = 29.97 Low = 15.04
Difference as % of Span: Mid = 0.30% Low = -0.12%

Measurement System Calibration Bias and Drift

Initial Bias Determination

Calibration Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv CO	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result
8:21	Zero Gas	-0.07	0.02	0.18%	Pass
8:37	Mid-range	30.12	29.67	-0.90%	Pass

Final Bias and Drift Determinations

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result	Drift, % of Span	Drift Check Result
9:31	Zero Gas	-0.02	0.10%	Pass	-0.08%	Pass
9:49	Mid-range	29.48	-1.28%	Pass	-0.38%	Pass

CO Measurement System Calibration Data (Method 10 & Method 6C)

Job No. 101494.1.004.02 Operator: Daniel Neal

Client: CCSI Date: 19-Jul-00

Plant: Gianera Generating Station

Location: Gas Turbine Outlet

Analyzer Calibration Error and Linearity Determination

Run Time: Start 11:20 End 11:52

Run No. 10 Load Condition: 100

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv CO	Calibration Gas Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv CO	Response Difference, % of Span	Cal. Error Check Result	Linearity Check Result
4:25	Zero Gas	0.00	N/A	-0.07	-0.14%	Pass	
4:28	High-range	44.90	AAL17607	45.04	0.28%	Pass	
4:31	Mid-range	29.90	AAL17607	30.12	0.44%	Pass	Pass
4:35	Low-range	15.04	AAL17607	14.98	-0.12%	Pass	Pass

Predicted value from linear curve, ppmv CO: Range: Mid = 29.97 Low = 15.04

Difference as % of Span: Mid = 0.30% Low = -0.12%

Measurement System Calibration Bias and Drift

Initial Bias Determination

Calibration Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv CO	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result
9:31	Zero Gas	-0.07	-0.02	0.10%	Pass
9:49	Mid-range	30.12	29.48	-1.28%	Pass

Final Bias and Drift Determinations

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result	Drift, % of Span	Drift Check Result
11:58	Zero Gas	-0.03	0.08%	Pass	-0.02%	Pass
12:15	Mid-range	29.68	-0.88%	Pass	0.40%	Pass

Analyzer Calibration Error and Linearity Determination

Run Time: Start 12:30 End 13:02

Run No. 11 Load Condition: 100

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv CO	Calibration Gas Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv CO	Response Difference, % of Span	Cal. Error Check Result	Linearity Check Result
4:25	Zero Gas	0.00	N/A	-0.07	-0.14%	Pass	
4:28	High-range	44.90	AAL17607	45.04	0.28%	Pass	
4:31	Mid-range	29.90	AAL17607	30.12	0.44%	Pass	Pass
4:35	Low-range	15.04	AAL17607	14.98	-0.12%	Pass	Pass

Predicted value from linear curve, ppmv CO: Range: Mid = 29.97 Low = 15.04

Difference as % of Span: Mid = 0.30% Low = -0.12%

Measurement System Calibration Bias and Drift

Initial Bias Determination

Calibration Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv CO	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result
11:58	Zero Gas	-0.07	-0.03	0.08%	Pass
12:15	Mid-range	30.12	29.68	-0.88%	Pass

Final Bias and Drift Determinations

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result	Drift, % of Span	Drift Check Result
13:10	Zero Gas	-0.03	0.08%	Pass	0.00%	Pass
13:25	Mid-range	29.67	-0.90%	Pass	-0.02%	Pass

CO Measurement System Calibration Data (Method 10 & Method 6C)

Job No. 101494.1.004.02 Operator: Daniel Neal

Client: CCSI Date: 19-Jul-00

Plant: Gianera Generating Station

Location: Gas Turbine Outlet

Analyzer Calibration Error and Linearity Determination

Run Time: Start 13:36 End 14:08

Run No. 12 Load Condition: 100

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv CO	Calibration Gas Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv CO	Response Difference, % of Span	Cal. Error Check Result	Linearity Check Result
4:25	Zero Gas	0.00	N/A	-0.07	-0.14%	Pass	
4:28	High-range	44.90	AAL17607	45.04	0.28%	Pass	
4:31	Mid-range	29.90	AAL17607	30.12	0.44%	Pass	Pass
4:35	Low-range	15.04	AAL17607	14.98	-0.12%	Pass	Pass

Predicted value from linear curve, ppmv CO: Range: Mid = 29.97 Low = 15.04

Difference as % of Span: Mid = 0.30% Low = -0.12%

Measurement System Calibration Bias and Drift

Initial Bias Determination

Calibration Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv CO	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result
13:10	Zero Gas	-0.07	-0.03	0.08%	Pass
13:25	Mid-range	30.12	29.67	-0.90%	Pass

Final Bias and Drift Determinations

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv CO	System Cal. Bias, % of Span	Bias Check Result	Drift, % of Span	Drift Check Result
14:12	Zero Gas	-0.06	0.02%	Pass	-0.06%	Pass
14:31	Mid-range	29.73	-0.78%	Pass	0.12%	Pass

O_2 Measurement System Calibration Data By Method 20

Job No. 101494.1.004.02 | Operator: Daniel Neal
Client: CCSI | Date: 18-Jul-00
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Analyzer Type: Magnetopneumatic | Analyzer Mfgr.: Servomex
Analyzer Span: 25 %O_2 by volume | Model No. 01440CISTD
Zero Gas: Prepurified nitrogen | Serial No. 1391
High-level Gas: Oxygen in nitrogen
Mid-level Gas: Oxygen in nitrogen

System Calibration Check Data

Run No. 1	Load Condition:	100				Run Time:	Start 7:00	End 7:32
Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, %O_2	Cylinder ID Number	Analyzer Response Value, %O_2: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
5:11	Zero Gas	0.00	N/A	0.04	0.11		0.28%	Pass
5:31	High-level	20.90	ALM007829	21.05		Pass		
5:29	Mid-level	11.99	ALM007829	12.06	11.99		-0.28%	Pass
Predicted value from linear curve, %O_2:				20.99		Difference as % of Span:		0.23%

a. High-level response before run must agree with predicted value on linear curve within 2% of the span value.

b. Drift check must not exceed ±2% of the span value.

$$\text{Percent Drift} = \frac{\text{Absolute difference}}{\text{Span}} \times 100$$

Response Time Determination

Reading	Downscale Response, seconds			Upscale Response, seconds		
1	25			23		
2	25			25		
3	24	Average:	25	26	Average:	25
System Response Time (slower average time) =			25	seconds		

System Calibration Check Data (continued)

Run No. 2	Load Condition:	100				Run Time:	Start 8:10	End 8:42
Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, %O_2	Cylinder ID Number	Analyzer Response Value, %O_2: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
8:48	Zero Gas	0.00	N/A	0.11	0.11		0.00%	Pass
	High-level	N/A	N/A	N/A		N/A		
8:53	Mid-level	11.99	ALM007829	11.99	11.98		-0.04%	Pass
Predicted value from linear curve, %O_2:				N/A		Difference as % of Span:		N/A

Run No. 3	Load Condition:	100				Run Time:	9:20	9:52
Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, %O_2	Cylinder ID Number	Analyzer Response Value, %O_2: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
9:56	Zero Gas	0.00	N/A	0.11	0.14		0.12%	Pass
	High-level	N/A	N/A	N/A		N/A		
10:00	Mid-level	11.99	ALM007829	11.98	12.06		0.32%	Pass
Predicted value from linear curve, %O_2:				N/A		Difference as % of Span:		N/A

O_2 Measurement System Calibration Data By Method 20

Job No. 101494.1.004.02
Client: CCSI
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Operator: Daniel Neal
Date: 18-Jul-00

Analyzer Type: Magnetopneumatic
Analyzer Span: 25 $\%O_2$ by volume
Zero Gas: Prepurified nitrogen
High-level Gas: Oxygen in nitrogen
Mid-level Gas: Oxygen in nitrogen

Analyzer Mfgr.: Servomex
Model No. 01440CISTD
Serial No. 1391

System Calibration Check Data

Run Time: Start 16:40 End 17:12

Run No. 4 **Load Condition: 100**

Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, $\%O_2$		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, $\%O_2$	Cylinder ID Number	Before Run	After Run			
15:20	Zero Gas	0.00	N/A	0.05	0.12		0.28%	Pass
15:25	High-level	20.90	ALM007829	20.98		Pass		
15:22	Mid-level	11.99	ALM007829	12.01	12.00		-0.04%	Pass
	Predicted value from linear curve, $\%O_2$:			20.90		Difference as % of Span:		0.33%

a. High-level response before run must agree with predicted value on linear curve within 2% of the span value.
b. Drift check must not exceed ±2% of the span value.

$$\text{Percent Drift} = \frac{\text{Absolute difference}}{\text{Span}} \times 100$$

Response Time Determination

Reading	Downscale Response, seconds			Upscale Response, seconds		
1	N/A			N/A		
2	N/A			N/A		
3	N/A	Average:	N/A	N/A	Average:	N/A
System Response Time (slower average time) =			N/A			seconds

System Calibration Check Data (continued)

Run Time: Start 17:50 End 18:22

Run No. 5 **Load Condition: 100**

Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, $\%O_2$		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, $\%O_2$	Cylinder ID Number	Before Run	After Run			
18:28	Zero Gas	0.00	N/A	0.12	0.12		0.00%	Pass
	High-level	N/A	N/A	N/A		N/A		
18:34	Mid-level	11.99	ALM007829	12.00	11.95		-0.20%	Pass
	Predicted value from linear curve, $\%O_2$:			N/A		Difference as % of Span:		N/A

Run No. 6 **Load Condition: 100** Run Time: 18:58 19:30

Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, $\%O_2$		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, $\%O_2$	Cylinder ID Number	Before Run	After Run			
19:34	Zero Gas	0.00	N/A	0.12	0.08		-0.16%	Pass
	High-level	N/A	N/A	N/A		N/A		
19:39	Mid-level	11.99	ALM007829	11.95	11.95		0.00%	Pass
	Predicted value from linear curve, $\%O_2$:			N/A		Difference as % of Span:		N/A

O_2 Measurement System Calibration Data By Method 20

Job No. 101494.1.004.02
Client: CCSI
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Operator: Daniel Neal
Date: 19-Jul-00

Analyzer Type: Magnetopneumatic
Analyzer Span: 25 $\%O_2$ by volume
Zero Gas: Prepurified nitrogen
High-level Gas: Oxygen in nitrogen
Mid-level Gas: Oxygen in nitrogen

Analyzer Mfgr.: Servomex
Model No. 01440CISTD
Serial No. 1391

System Calibration Check Data

Run No. 7	Load Condition:	100				Run Time:	Start 6:40	End 7:12
Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, $\%O_2$		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, $\%O_2$	Cylinder ID Number	Before Run	After Run			
4:41	Zero Gas	0.00	N/A	0.02	0.07		0.20%	Pass
4:51	High-level	20.90	ALM007829	20.93		Pass		
4:46	Mid-level	11.99	ALM007829	11.95	11.98		0.12%	Pass
Predicted value from linear curve, $\%O_2$:				20.82		Difference as % of Span:		0.46%

a. High-level response before run must agree with predicted value on linear curve within 2% of the span value.

b. Drift check must not exceed ±2% of the span value.

$$\text{Percent Drift} = \frac{\text{Absolute difference}}{\text{Span}} \times 100$$

Response Time Determination

Reading	Downscale Response, seconds			Upscale Response, seconds		
1	N/A			N/A		
2	N/A			N/A		
3	N/A	Average:	N/A	N/A	Average:	N/A
System Response Time (slower average time) =			N/A			seconds

System Calibration Check Data (continued)

Run No. 8	Load Condition:	100				Run Time:	Start 7:45	End 8:17
Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, $\%O_2$		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, $\%O_2$	Cylinder ID Number	Before Run	After Run			
8:21	Zero Gas	0.00	N/A	0.07	0.12		0.20%	Pass
	High-level	N/A	N/A	N/A		N/A		
8:25	Mid-level	11.99	ALM007829	11.98	12.01		0.12%	Pass
Predicted value from linear curve, $\%O_2$:				N/A		Difference as % of Span:		N/A

Run No. 9	Load Condition:	100				Run Time:	8:50	9:22
Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, $\%O_2$		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, $\%O_2$	Cylinder ID Number	Before Run	After Run			
9:30	Zero Gas	0.00	N/A	0.12	0.14		0.08%	Pass
	High-level	N/A	N/A	N/A		N/A		
9:36	Mid-level	11.99	ALM007829	12.01	11.96		-0.20%	Pass
Predicted value from linear curve, $\%O_2$:				N/A		Difference as % of Span:		N/A

O_2 Measurement System Calibration Data By Method 20

Job No. 101494.1.004.02 Operator: Daniel Neal

Client: CCSI Date: 19-Jul-00

Plant: Gianera Generating Station

Location: Gas Turbine Outlet

System Calibration Check Data (continued)

Run No. 10	Load Condition:	100				Run Time:	Start 11:20	End 11:52
Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, $\%O_2$		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, $\%O_2$	Cylinder ID Number	Before Run	After Run			
11:58	Zero Gas	0.00	N/A	0.14	0.12		-0.08%	Pass
	High-level	N/A	N/A	N/A		N/A		
12:01	Mid-level	11.99	ALM007829	11.96	11.97		0.04%	Pass
Predicted value from linear curve, $\%O_2$:				N/A		Difference as % of Span:		N/A

Run No. 11	Load Condition:	100				Run Time:	12:30	13:02
Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, $\%O_2$		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, $\%O_2$	Cylinder ID Number	Before Run	After Run			
13:10	Zero Gas	0.00	N/A	0.12	0.05		-0.28%	Pass
	High-level	N/A	N/A	N/A		N/A		
13:13	Mid-level	11.99	ALM007829	11.97	12.00		0.12%	Pass
Predicted value from linear curve, $\%O_2$:				N/A		Difference as % of Span:		N/A

Run No. 12	Load Condition:	100				Run Time:	13:36	14:08
Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, $\%O_2$		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, $\%O_2$	Cylinder ID Number	Before Run	After Run			
14:12	Zero Gas	0.00	N/A	0.05	0.11		0.24%	Pass
	High-level	N/A	N/A	N/A		N/A		
14:16	Mid-level	11.99	ALM007829	12.00	11.93		-0.28%	Pass
Predicted value from linear curve, $\%O_2$:				N/A		Difference as % of Span:		N/A

CO_2 Measurement System Calibration Data By Method 20

Job No. 101494.1.004.02 | Operator: Daniel Neal
Client: CCSI | Date: 18-Jul-00
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Analyzer Type: Single beam, dual wavelength IR | Analyzer Mfgr.: Servomex
Analyzer Span: 20 %CO_2 by volume | Model No. 01440CISTD
Zero Gas: Prepurified nitrogen | Serial No. 1382
High-level Gas: Carbon dioxide in nitrogen
Mid-level Gas: Carbon dioxide in nitrogen

System Calibration Check Data

Run Time: Start 7:00 | End 7:32

Run No. 1 **Load Condition: 100**

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, %CO_2	Cylinder ID Number	Analyzer Response Value, %CO_2: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
5:18	Zero Gas	0.00	N/A	-0.04	-0.03		0.05%	Pass
5:38	High-level	9.98	AAL19060	10.35		Pass		
5:35	Mid-level	3.01	AAL19060	3.08	3.06		-0.10%	Pass
	Predicted value from linear curve, %CO_2:			10.30		Difference as % of Span:		0.23%

a. High-level response before run must agree with predicted value on linear curve within 2% of the span value.

b. Drift check must not exceed ±2% of the span value.

$$\text{Percent Drift} = \frac{\text{Absolute difference}}{\text{Span}} \times 100$$

Response Time Determination

Reading	Downscale Response, seconds		Upscale Response, seconds	
1	25		22	
2	24		22	
3	23	Average: 24	21	Average: 22
System Response Time (slower average time) =		24 seconds		

System Calibration Check Data (continued)

Run Time: Start 8:10 | End 8:42

Run No. 2 **Load Condition: 100**

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, %CO_2	Cylinder ID Number	Analyzer Response Value, %CO_2: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
8:50	Zero Gas	0.00	N/A	-0.03	0.12		0.75%	Pass
	High-level	N/A	N/A	N/A		N/A		
8:56	Mid-level	3.01	AAL19060	3.06	3.06		0.00%	Pass
	Predicted value from linear curve, %CO_2:			N/A		Difference as % of Span:		N/A

Run No. 3 **Load Condition: 100** Run Time: 9:20 | 9:52

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Value, %CO_2	Cylinder ID Number	Analyzer Response Value, %CO_2: Before Run	After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
9:56	Zero Gas	0.00	N/A	0.12	0.16		0.20%	Pass
	High-level	N/A	N/A	N/A		N/A		
10:03	Mid-level	3.01	AAL19060	3.06	3.07		0.05%	Pass
	Predicted value from linear curve, %CO_2:			N/A		Difference as % of Span:		N/A

CO_2 Measurement System Calibration Data By Method 20

Job No. 101494.1.004.02
Client: CCSI
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Operator: Daniel Neal
Date: 18-Jul-00

Analyzer Type: Single beam, dual wavelength IR
Analyzer Span: 20 $\%CO_2$ by volume
Zero Gas: Prepurified nitrogen
High-level Gas: Carbon dioxide in nitrogen
Mid-level Gas: Carbon dioxide in nitrogen

Analyzer Mfgr.: Servomex
Model No. 01440CISTD
Serial No. 1382

System Calibration Check Data

Run No. 4 Load Condition: 100

Run Time: Start 16:40 End 17:12

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Calibration Gas: Value, $\%CO_2$	Calibration Gas: Cylinder ID Number	Analyzer Response Value, $\%CO_2$: Before Run	Analyzer Response Value, $\%CO_2$: After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
15:20	Zero Gas	0.00	N/A	0.12	0.07		-0.25%	Pass
15:38	High-level	9.98	AAL19060	9.59		Pass		
15:35	Mid-level	3.01	AAL19060	2.95	3.17		1.10%	Pass
Predicted value from linear curve, $\%CO_2$:				9.50		Difference as % of Span:		0.43%

a. High-level response before run must agree with predicted value on linear curve within 2% of the span value.

b. Drift check must not exceed ±2% of the span value.

$$\text{Percent Drift} = \frac{\text{Absolute difference}}{\text{Span}} \times 100$$

Response Time Determination

Reading	Downscale Response, seconds			Upscale Response, seconds		
1	N/A			N/A		
2	N/A			N/A		
3	N/A	Average:	N/A	N/A	Average:	N/A
System Response Time (slower average time) =			N/A			seconds

System Calibration Check Data (continued)

Run No. 5 Load Condition: 100

Run Time: Start 17:50 End 18:22

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Calibration Gas: Value, $\%CO_2$	Calibration Gas: Cylinder ID Number	Analyzer Response Value, $\%CO_2$: Before Run	Analyzer Response Value, $\%CO_2$: After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
18:28	Zero Gas	0.00	N/A	0.07	-0.02		-0.45%	Pass
	High-level	N/A	N/A	N/A		N/A		
18:37	Mid-level	3.01	AAL19060	3.17	2.98		-0.95%	Pass
Predicted value from linear curve, $\%CO_2$:				N/A		Difference as % of Span:		N/A

Run No. 6 Load Condition: 100

Run Time: 18:58 19:30

Calibration After Run Ending Time	Calibration Gas: Concentration Level	Calibration Gas: Value, $\%CO_2$	Calibration Gas: Cylinder ID Number	Analyzer Response Value, $\%CO_2$: Before Run	Analyzer Response Value, $\%CO_2$: After Run	Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
19:35	Zero Gas	0.00	N/A	-0.02	0.07		0.45%	Pass
	High-level	N/A	N/A	N/A		N/A		
19:42	Mid-level	3.01	AAL19060	2.98	2.93		-0.25%	Pass
Predicted value from linear curve, $\%CO_2$:				N/A		Difference as % of Span:		N/A

CO_2 Measurement System Calibration Data By Method 20

Job No. 101494.1.004.02 | Operator: Daniel Neal
Client: CCSI | Date: 19-Jul-00
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Analyzer Type: Single beam, dual wavelength IR | Analyzer Mfgr.: Servomex
Analyzer Span: 20 %CO_2 by volume | Model No. 01440CISTD
Zero Gas: Prepurified nitrogen | Serial No. 1382
High-level Gas: Carbon dioxide in nitrogen
Mid-level Gas: Carbon dioxide in nitrogen

System Calibration Check Data

Run No. 7	Load Condition:	100				Run Time:	Start 6:40	End 7:12
Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, %CO_2		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, %CO_2	Cylinder ID Number	Before Run	After Run			
5:35	Zero Gas	0.00	N/A	0.16	0.07		-0.45%	Pass
5:47	High-level	9.98	AAL19060	9.21		Pass		
5:44	Mid-level	3.01	AAL19060	2.90	3.06		0.80%	Pass
Predicted value from linear curve, %CO_2:				9.24		Difference as % of Span:		-0.17%

a. High-level response before run must agree with predicted value on linear curve within 2% of the span value.

b. Drift check must not exceed ±2% of the span value.

$$\text{Percent Drift} = \frac{\text{Absolute difference}}{\text{Span}} \times 100$$

Response Time Determination

Reading	Downscale Response, seconds			Upscale Response, seconds		
1	N/A			N/A		
2	N/A			N/A		
3	N/A	Average:	N/A	N/A	Average:	N/A
System Response Time (slower average time) =			N/A			seconds

System Calibration Check Data (continued)

Run No. 8	Load Condition:	100				Run Time:	Start 7:45	End 8:17
Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, %CO_2		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, %CO_2	Cylinder ID Number	Before Run	After Run			
8:21	Zero Gas	0.00	N/A	0.07	0.04		-0.15%	Pass
	High-level	N/A	N/A	N/A		N/A		
8:28	Mid-level	3.01	AAL19060	3.06	3.05		-0.05%	Pass
Predicted value from linear curve, %CO_2:				N/A		Difference as % of Span:		N/A

Run No. 9	Load Condition:	100				Run Time:	8:50	9:22
Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, %CO_2		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, %CO_2	Cylinder ID Number	Before Run	After Run			
9:30	Zero Gas	0.00	N/A	0.04	0.01		-0.15%	Pass
	High-level	N/A	N/A	N/A		N/A		
9:39	Mid-level	3.01	AAL19060	3.05	3.07		0.10%	Pass
Predicted value from linear curve, %CO_2:				N/A		Difference as % of Span:		N/A

CO_2 Measurement System Calibration Data By Method 20

Job No. 101494.1.004.02 Operator: Daniel Neal

Client: CCSI Date: 19-Jul-00

Plant: Gianera Generating Station

Location: Gas Turbine Outlet

System Calibration Check Data (continued)

Run No. 10	Load Condition:	100				Run Time:	Start 11:20	End 11:52
Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, $\%CO_2$		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, $\%CO_2$	Cylinder ID Number	Before Run	After Run			
11:58	Zero Gas	0.00	N/A	0.01	0.01		0.00%	Pass
	High-level	N/A	N/A	N/A		N/A		
12:04	Mid-level	3.01	AAL19060	3.07	3.06		-0.05%	Pass
Predicted value from linear curve, $\%CO_2$:				N/A		Difference as % of Span:		N/A

Run No. 11	Load Condition:	100				Run Time:	12:30	13:02
Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, $\%CO_2$		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, $\%CO_2$	Cylinder ID Number	Before Run	After Run			
13:10	Zero Gas	0.00	N/A	0.01	0.25		1.20%	Pass
	High-level	N/A	N/A	N/A		N/A		
13:16	Mid-level	3.01	AAL19060	3.06	2.82		-1.20%	Pass
Predicted value from linear curve, $\%CO_2$:				N/A		Difference as % of Span:		N/A

Run No. 12	Load Condition:	100				Run Time:	13:36	14:08
Calibration After Run Ending Time	Calibration Gas			Analyzer Response Value, $\%CO_2$		Response Agreement with Curve[a]	Difference (Drift) After Run, % of Span	Drift Check Result[b]
	Concentration Level	Value, $\%CO_2$	Cylinder ID Number	Before Run	After Run			
14:12	Zero Gas	0.00	N/A	0.25	0.21		-0.20%	Pass
	High-level	N/A	N/A	N/A		N/A		
14:19	Mid-level	3.01	AAL19060	2.82	2.83		0.05%	Pass
Predicted value from linear curve, $\%CO_2$:				N/A		Difference as % of Span:		N/A

TGOC Measurement System Calibration Data By Method 25A

Job No. 101494.1.004.02 Operator: Daniel Neal
Client: CCSI Date: 18-Jul-00
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Analyzer Type: Flame ionization using an FID Manufacturer: J.U.M. Engineering
Analyzer Span: 100 ppmv Propane Model No. VE 7
Zero Gas: Prepurified nitrogen Serial No. 102011192
Cal. Gas Mixture: Propane in nitrogen

Measurement System Calibration Error Determination

Run No. 1	Load Condition:	100			Sampling Time:	Start 7:00	End 7:32
Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv	Calibration Gas Cylinder ID Number	System Response Value Following Calibration, ppmv	Predicted Value, ppmv	Response Difference, % of PV	Cal. Error Check Result[a]
6:32	Zero Gas	0.00	N/A	-0.02			
6:38	High-level	84.90	ALM023230	85.07			
6:41	Mid-level	49.90	ALM023230	49.99	49.99	0.00%	Pass
6:44	Low-level	29.90	ALM023230	29.89	29.95	-0.19%	Pass

a. The difference between the analyzer response and the predicted value on the linear curve must be less than ±5% of the predicted value (PV).

Response Time Determination

Reading	Upscale Response, seconds
1	17
2	21
3	19

System Response Time (average) = 19 seconds

Measurement System Drift

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv Before	System Response, ppmv After	Difference (Drift), ppmv	System Drift, % of Span	Drift Check Result[b]	
7:58	Zero Gas	-0.02	-0.06	-0.04	-0.04%	Pass	
8:01	Mid-level	49.99	49.90	-0.09	-0.09%	Pass	

b. Drift must be less than ±3% of the span value.

$$\text{Drift} = \frac{\text{Final System Cal. Response - Initial System Cal. Response}}{\text{Span}} \times 100$$

Measurement System Calibration Error Determination

Run No. 2	Load Condition:	100			Sampling Time:	Start 8:10	End 8:42
Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv	Calibration Gas Cylinder ID Number	System Response Value Following Calibration, ppmv	Predicted Value, ppmv	Response Difference, % of PV	Cal. Error Check Result
	Zero Gas	0.00	N/A	N/A			
	High-level	N/A	N/A	N/A			
	Mid-level	49.90	ALM023230	N/A	N/A	N/A	N/A
	Low-level	N/A	N/A	N/A	N/A	N/A	N/A

Measurement System Drift

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv Before	System Response, ppmv After	Difference (Drift), ppmv	System Drift, % of Span	Drift Check Result	
9:10	Zero Gas	-0.06	-0.07	-0.01	-0.01%	Pass	
9:17	Mid-level	49.90	49.49	-0.41	-0.41%	Pass	

TGOC Measurement System Calibration Data By Method 25A

Job No. 101494.1.004.02
Client: CCSI
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Operator: Daniel Neal
Date: 18-Jul-00

Measurement System Calibration Error Determination

Run No. 3	Load Condition:	100			Sampling Time:	Start 9:20	End 9:52
Calibration Ending Time	Calibration Gas			System Response Value Following Calibration, ppmv	Predicted Value, ppmv	Response Difference, % of PV	Cal. Error Check Result
	Concentration Level	Value, ppmv	Cylinder ID Number				
	Zero Gas	N/A	N/A	N/A			
	High-level	N/A	N/A	N/A			
	Mid-level	49.90	ALM023230	N/A	N/A	N/A	N/A
	Low-level	N/A	N/A	N/A	N/A	N/A	N/A

Measurement System Drift

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv		Difference (Drift), ppmv	System Drift, % of Span	Drift Check Result	
		Before	After				
10:16	Zero Gas	-0.07	0.02	0.09	0.09%	Pass	
10:18	Mid-level	49.49	49.48	-0.01	-0.01%	Pass	

TGOC Measurement System Calibration Data By Method 25A

Job No. 101494.1.004.02
Client: CCSI
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Operator: Daniel Neal
Date: 18-Jul-00

Analyzer Type: Flame ionization using an FID
Analyzer Span: 100 ppmv Propane
Zero Gas: Prepurified nitrogen
Cal. Gas Mixture: Propane in nitrogen

Manufacturer: J.U.M. Engineering
Model No. VE 7
Serial No. 102011192

Measurement System Calibration Error Determination

Run No. 4	Load Condition:	100			Sampling Time:	Start 16:40	End 17:12
Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv	Calibration Gas Cylinder ID Number	System Response Value Following Calibration, ppmv	Predicted Value, ppmv	Response Difference, % of PV	Cal. Error Check Result[a]
16:13	Zero Gas	0.00	N/A	0.07			
16:17	High-level	84.98	ALM023230	85.47			
16:20	Mid-level	49.90	ALM023230	50.12	50.22	-0.19%	Pass
16:24	Low-level	29.90	ALM023230	30.00	30.12	-0.39%	Pass

a. The difference between the analyzer response and the predicted value on the linear curve must be less than ±5% of the predicted value (PV).

Response Time Determination

Reading	Upscale Response, seconds
1	N/A
2	N/A
3	N/A

System Response Time (average) = N/A seconds

Measurement System Drift

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv Before	System Response, ppmv After	Difference (Drift), ppmv	System Drift, % of Span	Drift Check Result[b]
17:40	Zero Gas	0.07	-0.06	-0.13	-0.13%	Pass
17:43	Mid-level	50.12	49.79	-0.33	-0.33%	Pass

b. Drift must be less than ±3% of the span value.

$$\text{Drift} = \frac{\text{Final System Cal. Response} - \text{Initial System Cal. Response}}{\text{Span}} \times 100$$

Measurement System Calibration Error Determination

Run No. 5	Load Condition:	100			Sampling Time:	Start 17:50	End 18:22
Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv	Calibration Gas Cylinder ID Number	System Response Value Following Calibration, ppmv	Predicted Value, ppmv	Response Difference, % of PV	Cal. Error Check Result
	Zero Gas	N/A	N/A	N/A			
	High-level	N/A	N/A	N/A			
	Mid-level	49.90	ALM023230	N/A	N/A	N/A	N/A
	Low-level	N/A	N/A	N/A	N/A	N/A	N/A

Measurement System Drift

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv Before	System Response, ppmv After	Difference (Drift), ppmv	System Drift, % of Span	Drift Check Result
18:51	Zero Gas	-0.06	0.01	0.07	0.07%	Pass
18:54	Mid-level	49.79	50.15	0.36	0.36%	Pass

TGOC Measurement System Calibration Data By Method 25A

Job No. 101494.1.004.02 Operator: Daniel Neal

Client: CCSI Date: 18-Jul-00

Plant: Gianera Generating Station

Location: Gas Turbine Outlet

Measurement System Calibration Error Determination

Run No. 6	Load Condition:	100			Sampling Time:	Start 18:58	End 19:30
Calibration Ending Time	Calibration Gas			System Response Value Following Calibration, ppmv	Predicted Value, ppmv	Response Difference, % of PV	Cal. Error Check Result
	Concentration Level	Value, ppmv	Cylinder ID Number				
	Zero Gas	N/A	N/A	N/A			
	High-level	N/A	N/A	N/A			
	Mid-level	49.90	ALM023230	N/A	N/A	N/A	N/A
	Low-level	N/A	N/A	N/A	N/A	N/A	N/A

Measurement System Drift

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv		Difference (Drift), ppmv	System Drift, % of Span	Drift Check Result	
		Before	After				
19:56	Zero Gas	0.01	-0.09	-0.10	-0.10%	Pass	
20:00	Mid-level	50.15	49.95	-0.20	-0.20%	Pass	

TGOC Measurement System Calibration Data By Method 25A

Job No. 101494.1.004.02 Operator: Daniel Neal
Client: CCSI Date: 19-Jul-00
Plant: Gianera Generating Station
Location: Gas Turbine Outlet

Analyzer Type: Flame ionization using an FID Manufacturer: J.U.M. Engineering
Analyzer Span: 100 ppmv Propane Model No. VE 7
Zero Gas: Prepurified nitrogen Serial No. 102011192
Cal. Gas Mixture: Propane in nitrogen

Measurement System Calibration Error Determination

Run No. 7	Load Condition:	100			Sampling Time:	Start 6:40	End 7:12
Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv	Calibration Gas Cylinder ID Number	System Response Value Following Calibration, ppmv	Predicted Value, ppmv	Response Difference, % of PV	Cal. Error Check Result[a]
6:13	Zero Gas	0.00	N/A	0.02			
6:19	High-level	84.96	ALM023230	85.04			
6:22	Mid-level	49.94	ALM023230	49.95	50.00	-0.09%	Pass
6:25	Low-level	29.92	ALM023230	30.00	29.96	0.13%	Pass

a. The difference between the analyzer response and the predicted value on the linear curve must be less than ±5% of the predicted value (PV).

Response Time Determination

Reading	Upscale Response, seconds
1	N/A
2	N/A
3	N/A

System Response Time (average) = N/A seconds

Measurement System Drift

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv Before	System Response, ppmv After	Difference (Drift), ppmv	System Drift, % of Span	Drift Check Result[b]
7:36	Zero Gas	0.02	-0.07	-0.09	-0.09%	Pass
7:40	Mid-level	49.95	49.63	-0.32	-0.32%	Pass

b. Drift must be less than ±3% of the span value.

$$\text{Drift} = \frac{\text{Final System Cal. Response - Initial System Cal. Response}}{\text{Span}} \times 100$$

Measurement System Calibration Error Determination

Run No. 8	Load Condition:	100			Sampling Time:	Start 7:45	End 8:17
Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv	Calibration Gas Cylinder ID Number	System Response Value Following Calibration, ppmv	Predicted Value, ppmv	Response Difference, % of PV	Cal. Error Check Result
	Zero Gas	N/A	N/A	N/A			
	High-level	N/A	N/A	N/A			
	Mid-level	49.94	ALM023230	N/A	N/A	N/A	N/A
	Low-level	N/A	N/A	N/A	N/A	N/A	N/A

Measurement System Drift

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv Before	System Response, ppmv After	Difference (Drift), ppmv	System Drift, % of Span	Drift Check Result
8:40	Zero Gas	-0.07	0.01	0.08	0.08%	Pass
8:44	Mid-level	49.63	49.27	-0.36	-0.36%	Pass

TGOC Measurement System Calibration Data By Method 25A

Job No. 101494.1.004.02 Operator: Daniel Neal

Client: CCSI Date: 19-Jul-00

Plant: Gianera Generating Station

Location: Gas Turbine Outlet

Measurement System Calibration Error Determination

Run No. 9	Load Condition:	100			Sampling Time:	Start 8:50	End 9:22
Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv	Calibration Gas Cylinder ID Number	System Response Value Following Calibration, ppmv	Predicted Value, ppmv	Response Difference, % of PV	Cal. Error Check Result
	Zero Gas	N/A	N/A	N/A			
	High-level	N/A	N/A	N/A			
	Mid-level	49.94	ALM023230	N/A	N/A	N/A	N/A
	Low-level	N/A	N/A	N/A	N/A	N/A	N/A

Measurement System Drift

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv Before	System Response, ppmv After	Difference (Drift), ppmv	System Drift, % of Span	Drift Check Result
9:54	Zero Gas	0.01	0.33	0.32	0.32%	Pass
9:58	Mid-level	49.27	49.07	-0.20	-0.20%	Pass

Measurement System Calibration Error Determination

Run No. 10	Load Condition:	100			Sampling Time:	Start 11:20	End 11:52
Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv	Calibration Gas Cylinder ID Number	System Response Value Following Calibration, ppmv	Predicted Value, ppmv	Response Difference, % of PV	Cal. Error Check Result
	Zero Gas	N/A	N/A	N/A			
	High-level	N/A	N/A	N/A			
	Mid-level	49.94	ALM023230	N/A	N/A	N/A	N/A
	Low-level	N/A	N/A	N/A	N/A	N/A	N/A

Measurement System Drift

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv Before	System Response, ppmv After	Difference (Drift), ppmv	System Drift, % of Span	Drift Check Result
12:19	Zero Gas	0.33	0.07	-0.26	-0.26%	Pass
12:25	Mid-level	49.07	49.00	-0.07	-0.07%	Pass

Measurement System Calibration Error Determination

Run No. 11	Load Condition:	100			Sampling Time:	Start 12:30	End 13:02
Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv	Calibration Gas Cylinder ID Number	System Response Value Following Calibration, ppmv	Predicted Value, ppmv	Response Difference, % of PV	Cal. Error Check Result
	Zero Gas	N/A	N/A	N/A			
	High-level	N/A	N/A	N/A			
	Mid-level	49.94	ALM023230	N/A	N/A	N/A	N/A
	Low-level	N/A	N/A	N/A	N/A	N/A	N/A

Measurement System Drift

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv Before	System Response, ppmv After	Difference (Drift), ppmv	System Drift, % of Span	Drift Check Result
13:28	Zero Gas	0.07	0.05	-0.02	-0.02%	Pass
13:32	Mid-level	49.00	48.58	-0.42	-0.42%	Pass

TGOC Measurement System Calibration Data By Method 25A

Job No. 101494.1.004.02 Operator: Daniel Neal

Client: CCSI Date: 19-Jul-00

Plant: Gianera Generating Station

Location: Gas Turbine Outlet

Measurement System Calibration Error Determination

Run No. 12 Load Condition: 100

Sampling Time:	Start 13:36	End 14:08

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv	Calibration Gas Cylinder ID Number	System Response Value Following Calibration, ppmv	Predicted Value, ppmv	Response Difference, % of PV	Cal. Error Check Result
	Zero Gas	N/A	N/A	N/A			
	High-level	N/A	N/A	N/A			
	Mid-level	49.94	ALM023230	N/A	N/A	N/A	N/A
	Low-level	N/A	N/A	N/A	N/A	N/A	N/A

Measurement System Drift

Calibration Ending Time	Calibration Gas Concentration Level	System Response, ppmv Before	System Response, ppmv After	Difference (Drift), ppmv	System Drift, % of Span	Drift Check Result
14:34	Zero Gas	0.05	0.02	-0.03	-0.03%	Pass
14:40	Mid-level	48.58	48.78	0.20	0.20%	Pass

A.2 Reference Method Performance Audit Results

NO_X Analyzer NO_2 To NO Converter Efficiency Check By Method 20

Job No. 101494.1.004.02
Client: CCSI
Plant: Cianera Generating Station

Operator: Daniel Neal
Date: 17-Jul-00

Analyzer Type: Chemiluminescent
Analyzer Span: 20 ppmv NO_X
Zero Gas: Prepurified nitrogen
High-level Gas: Nitrogen oxide in nitrogen
Mid-level Gas: Nitrogen oxide in nitrogen
Low-level Gas: Nitrogen oxide in nitrogen

Analyzer Mfgr.: Thermo Environmental Instr.
Model No. 42H
Serial No. 42H-41111-264

System Calibration Check Data

Calibration After CEC Ending Time	Calibration Gas			Analyzer Response Value, ppmv NO_X		Response Agreement with Curve[a]	Difference (Drift) After CEC, % of Span	Drift Check Result[b]
	Concentration Level	Value, ppmv NO_X	Cylinder ID Number	Before CEC	After CEC			
13:04	Zero Gas	0.00	N/A	-0.05	-0.05		0.00%	Pass
12:11	High-level	18.05	ALM048090	18.18		Pass		
13:08	Mid-level	10.03	ALM048090	10.19	9.87		-1.60%	Pass
12:15	Low-level	5.02	ALM048090	4.88		Pass		
	Predicted value from linear curve, ppmv NO_X					Difference as % of Span		
	High-level: 18.38		Low-level: 5.08			High-level: -0.99%	Low-level: -0.99%	

a. High-level response before run must agree with predicted value on linear curve within 2% of the span value.

b. Drift check must not exceed ±2% of the span value.

Response Time Determination

Reading	Downscale Response, seconds			Upscale Response, seconds		
1	N/A			N/A		
2	N/A			N/A		
3	N/A	Average:	N/A	N/A	Average:	N/A
System Response Time (slower average time) =			N/A seconds			

Analyzer Converter Efficiency Determination

Mid-level N0 in N_2 calibration gas diluted approximately 1:1 with ambient air.

Conversion Efficiency Check (1 min Average Readings)

Time 24-Hr	Minutes Elapsed	NO_X Reading	Time 24-Hr	Minutes Elapsed	NO_X Reading	Time 24-Hr	Minutes Elapsed	NO_X Reading
12:29	1	4.98	12:39	11	5.01	12:49	21	5.02
12:30	2	4.97	12:40	12	5.01	12:50	22	5.01
12:31	3	4.98	12:41	13	5.00	12:51	23	5.01
12:32	4	4.97	12:42	14	5.00	12:52	24	5.01
12:33	5	4.98	12:43	15	5.01	12:53	25	5.01
12:34	6	4.98	12:44	16	5.02	12:54	26	5.01
12:35	7	4.99	12:45	17	5.01	12:55	27	5.01
12:36	8	5.00	12:46	18	5.00	12:56	28	5.01
12:37	9	5.01	12:47	19	5.01	12:57	29	5.01
12:38	10	5.01	12:48	20	5.01	12:58	30	5.01

Highest Reading: 5.02 ppmv
Efficiency: 99.8% Percent decrease: 0.2% Result: Pass

* If the response at the end of 30 minutes decreases more than 2.0 percent of the highest peak value, the system is not acceptable.

NO2 Converter Check
Run 1
Time is 11:44:48.73.
Date is 7-17-2000

Time	NOx ppm
11:44	0.13
11:45	0.08
11:46	0.03
11:47	0.02
11:48	0
11:49	2.1
11:50	10.19
11:51	10.22
11:52	10.28
11:53	10.26
11:54	10.73
11:55	1.24
11:56	-0.03
11:57	-0.04
11:58	-0.05
11:59	-0.05
12:00	-0.05
12:01	4.61
12:02	10.11
12:03	10.19
12:04	10.2
12:05	10.2
12:06	9.86
12:07	9.98
12:08	9.98
12:09	15.67
12:10	18.19
12:11	18.18
12:12	11.18
12:13	4.95
12:14	4.89
12:15	4.88
12:16	1.93
12:17	-0.03
12:18	-0.05
12:19	-0.05
12:20	-0.06
12:21	-0.05
12:22	-0.05
12:23	-0.05
12:24	-0.05
12:25	-0.05
12:26	-0.05
12:27	0.18
12:28	5.75
12:29	4.98

12:30	4.97
12:31	4.98
12:32	4.97
12:33	4.98
12:34	4.98
12:35	4.99
12:36	5
12:37	5.01
12:38	5.01
12:39	5.01
12:40	5.01
12:41	5
12:42	5
12:43	5.01
12:44	5.02
12:45	5.01
12:46	5
12:47	5.01
12:48	5.01
12:49	5.02
12:50	5.01
12:51	5.01
12:52	5.01
12:53	5.01
12:54	5.01
12:55	5.01
12:56	5.01
12:57	5.01
12:58	5.01
12:59	4.78
13:00	0.45
13:01	-0.02
13:02	-0.03
13:03	-0.05
13:04	-0.05
13:05	6.46
13:06	9.75
13:07	9.9
13:08	9.87
13:09	9.85

Test Events Log Method 205

Job No. 101494.1.004.02 Operator: Daniel Neal

Client: CCSI Date: 17-Jul-00

Plant: Gianera Generating Station

Location: Gas Turbine Outlet

Method 205 test - MFC's 1& 2

19:30	Adjusted Photo Multiplier Tube to correct non-linearity of the analyzer, as per operators manual
19:34	Start zero cal for NO channel
19:37	Start high-range cal for NO channel
19:42	Start zero cal for NOx channel
19:45	Record zero cal
19:45	Start high-range cal for NOx channel
19:54	Record high-range cal and 1st upper point reading, switch from auto mode for cals to manual mode.
19:54	Start mid-range cal for NOx channel
19:57	Record mid-range cal for NOx channel and 1st lower point reading
19:57	1st mid-range gas standard injection
20:02	1st mid-range gas standard reading
20:02	2nd lower point injection
20:05	2nd lower point reading
20:05	2nd upper point injection
20:08	2nd upper point reading
20:08	2nd mid-range gas standard injection
20:11	2nd mid-range gas standard reading
20:11	3rd lower point injection
20:14	3rd lower point reading
20:14	3rd upper point injection
20:18	3rd upper point reading
20:18	3rd mid-range gas standard injection
20:22	3rd mid-range gas standard reading
20:22	Start zero drift check injection
20:26	Record zero drift check reading
20:26	Start mid-range drift check injection
20:30	Record mid-range drift check reading

Method 205 test - MFC's 1& 3

20:36	1st lower point injection
20:40	1st lower point reading
20:40	1st upper point injection
20:44	1st upper point reading
20:44	1st mid-range gas standard injection
20:48	1st mid-range gas standard reading
20:48	2nd lower point injection
20:52	2nd lower point reading
20:52	2nd upper point injection
20:56	2nd upper point reading
20:56	2nd mid-range gas standard injection
21:00	2nd mid-range gas standard reading
21:00	3rd lower point injection
21:04	3rd lower point reading
21:04	3rd upper point injection
21:08	3rd upper point reading

21:08	3rd mid-range gas standard injection
21:12	3rd mid-range gas standard reading
21:12	Start zero drift check injection
21:16	Record zero drift check reading
21:16	Start mid-range drift check injection
21:20	Record mid-range drift check reading

Method 205 Summary Data

Varification Of Mass Flow Controllers 1 and 2

Client:	CCSI	Job No.	101494.1.004.02
Plant:	Gianera Generating Station	Operator:	Daniel Neal
Location:	Gas Turbine Outlet	Date:	17-Jul-00

Reference Method Analyzer

(Used During This Test)

Manufacturer: Thermo Environmental Instr.
Model No. 42H
Analyzer Type: Chemiluminescent
Analyzer Range: 0-50 ppm
Serial No. 42H-41111-264
Cal. No. NOX-1

Calibration Gas Dilution Instrument

Manufacturer: Environics, Inc.
Model No. S-2020-R
Serial No. 2073
Last Calibrated: 11-Jul-00

EPA Protocol 1 Traceable Gases

High-Level (Dilution) Gas Standard Concentration: 201.85 ppm
Cylinder I.D. Number: ALM048090

Mid-Level Gas Standard Concentration: 25.59 ppm
Cylinder I.D. Number: AAL7388

High-Level (Dilution) Gas Standard Calibration Points	Dilution Instrument MFC Output Concentration		Analyzer Reading			Run vs Average (% Error)	MFC Output vs Average (% Error)
	Run	Value	As Read Per Run	Corrected for Cal. Results	Average		
Lower Point Injections	1	24.90	24.57	24.60		-0.18%	
	2	24.90	24.67	24.70	24.64	0.23%	1.03%
	3	24.90	24.60	24.63		-0.05%	
Upper Point Injections	1	44.90	44.97	45.07		-0.03%	
	2	44.90	45.03	45.13	45.08	0.10%	-0.40%
	3	44.90	44.95	45.05		-0.07%	

Mid-Level Gas Standard Calibration Points	Mid-Level Gas Standard Concentration		Analyzer Reading			Mid-Level Gas Standard vs Average (% Error)
	Run	Value	As Read Per Run	Corrected for Cal. Results	Average	
Mid-Level Injections	1	25.59	25.49	25.52		
	2	25.59	25.41	25.44	25.46	0.52%
	3	25.59	25.37	25.40		

All dilution points must be within ± 2% of analyzer reading

STATUS OF TEST: PASSED

Method 205 Summary Data

Varification Of Mass Flow Controllers 1 and 3

Client:	CCSI	Job No.	101494.1.004.02
Plant:	Gianera Generating Station	Operator:	Daniel Neal
Location:	Gas Turbine Outlet	Date:	17-Jul-00

Reference Method Analyzer
(Used During This Test)

Manufacturer: Thermo Environmental Instr
Model No. 42H
Analyzer Type: Chemiluminescent
Analyzer Range: 0-50 ppm
Serial No. 42H-41111-264
Cal. No. NOX-2

Calibration Dilution Instrument

Manufacturer: Environics, Inc.
Model No. S-2020-R
Serial No. 2073
Last Calibrated: 11-Jul-00

EPA Protocol 1 Traceable Gases

High-Level (Dilution) Gas Standard Concentration: 503.45 ppm
Cylinder I.D. Number: ALM055608

Mid-Level Gas Standard Concentration: 25.59 ppm
Cylinder I.D. Number: AAL7388

High-Level (Dilution) Gas Standard Calibration Points	Dilution Instrument MFC Output Concentration		Analyzer Reading			Run vs Average (% Error)	MFC Output vs Average (% Error)
	Run	Value	As Read Per Run	Corrected for Cal. Results	Average		
Lower Point Injections	1	25.07	24.51	24.68		0.16%	
	2	25.07	24.44	24.61	24.64	-0.12%	1.73%
	3	25.07	24.46	24.63		-0.04%	
Upper Point Injections	1	45.10	44.61	44.95		0.18%	
	2	45.10	44.51	44.85	44.87	-0.04%	0.51%
	3	45.10	44.47	44.81		-0.13%	

Mid-Level Gas Standard Calibration Points	Mid-Level Gas Standard Concentration		Analyzer Reading			Mid-Level Gas Standard vs Average (% Error)
	Run	Value	As Read Per Run	Corrected for Cal. Results	Average	
Mid-Level Injections	1	25.59	25.17	25.34		
	2	25.59	25.15	25.32	25.29	1.18%
	3	25.59	25.03	25.20		

All dilution points must be within ± 2% of analyzer reading

STATUS OF TEST: PASSED

M-205 Field Test
Run 1
Time is 17:27:52.44.
Date is 7-17-2000.

Time	NOx ppm
17:27	1.05
17:28	0.29
17:29	-0.01
17:30	-0.01
17:31	-0.01
17:32	-0.01
17:33	-0.01
17:34	-0.03
17:35	6.59
17:36	44.37
17:37	46.7
17:38	46.93
17:39	47.03
17:40	47.09
17:41	42.44
17:42	0.68
17:43	3.23
17:44	44.49
17:45	45.54
17:46	45.52
17:47	42.33
17:48	1.09
17:49	-0.01
17:50	-0.03
17:51	-0.07
17:52	-0.07
17:53	-0.07
17:54	0.09
17:55	-0.15
17:56	-0.17
17:57	7.01
17:58	43.92
17:59	45.2
18:00	45.18
18:01	45.17
18:02	45.17
18:03	45.02
18:04	44.65
18:05	44.8
18:06	44.95
18:07	44.96
18:08	44.97
18:09	28.77
18:10	25.3
18:11	26.96
18:12	24.47
18:13	36.13
18:14	22.52
18:15	30.16
18:16	27.85
18:17	24.5
18:18	29.8
18:19	44.94
18:20	45
18:21	45
18:22	45
18:23	32.89
18:24	24.47

18:25	24.49
18:26	24.35
18:27	3.23
18:28	0.56
18:29	0.04
18:30	0.03
18:31	-0.06
18:32	-0.05
18:33	0.01
18:34	12.9
18:35	46.7
18:36	47.28
18:37	45.46
18:38	46.61
18:39	44.51
18:40	9.71
18:41	0.04
18:42	-0.03
18:43	0
18:44	12.89
18:45	44.78
18:46	45.07
18:47	44.84
18:48	44.88
18:49	44.86
18:50	44.33
18:51	25.95
18:52	24.49
18:53	24.51
18:54	24.52
18:55	30.43
18:56	44.85
18:57	44.92
18:58	44.98
18:59	45.19
19:00	45.2
19:01	44.83
19:02	44.71
19:03	28.56
19:04	24.46
19:05	21.79
19:06	14.53
19:07	14.74
19:08	28.01
19:09	29.6
19:10	29.86
19:11	43.88
19:12	44.96
19:13	44.78
19:14	26.16
19:15	23.95
19:16	25.27
19:17	25.01
19:18	30.81
19:19	45.78
19:20	45.52
19:21	45.3
19:22	45.31
19:23	45.94
19:24	42.45
19:25	40.23
19:26	40.19
19:27	40.15
19:28	40.08

19:29	40.15
19:30	39.79
19:31	40.14
19:32	40.28
19:33	40.23
19:34	39.72
19:35	6.77
19:36	0.05
19:37	0.06
19:38	27.83
19:39	45.19
19:40	45.25
19:41	45.24
19:42	45.18
19:43	17.77
19:44	0.05
19:45	0.05
19:46	0.77
19:47	41.38
19:48	45.07
19:49	45.15
19:50	45.19
19:51	45.18
19:52	45.11
19:53	44.96
19:54	44.97
19:55	39.7
19:56	24.62
19:57	24.57
19:58	24.56
19:59	24.33
20:00	25.36
20:01	25.49
20:02	25.49
20:03	26.49
20:04	24.94
20:05	24.67
20:06	30
20:07	45.03
20:08	45.03
20:09	39.25
20:10	25.45
20:11	25.41
20:12	25.37
20:13	24.67
20:14	24.6
20:15	24.75
20:16	43.43
20:17	44.97
20:18	44.95
20:19	44.74
20:20	27.01
20:21	25.39
20:22	25.38
20:23	21.78
20:24	0.98
20:25	0.05
20:26	0.05
20:27	8.39
20:28	24.3
20:29	24.51
20:30	24.51
20:31	18.5
20:32	0.89

20:33	0.49
20:34	5.58
20:35	1.67
20:36	20.57
20:37	23.44
20:38	24.22
20:39	24.45
20:40	24.51
20:41	35.44
20:42	44.65
20:43	44.62
20:44	44.61
20:45	32.34
20:46	25.21
20:47	25.17
20:48	25.17
20:49	27.97
20:50	24.42
20:51	24.43
20:52	24.44
20:53	37.37
20:54	44.52
20:55	44.52
20:56	44.51
20:57	31.99
20:58	25.12
20:59	25.14
21:00	25.15
21:01	27.85
21:02	24.43
21:03	24.46
21:04	24.46
21:05	38.45
21:06	44.54
21:07	44.5
21:08	44.47
21:09	30.81
21:10	25.08
21:11	25.05
21:12	25.03
21:13	24.95
21:14	0.12
21:15	0.04
21:16	0.04
21:17	14.58
21:18	24.15
21:19	24.22
21:20	24.24
21:21	12.3
21:22	0.05
21:23	-0.02
21:24	-0.02
21:25	-0.04

NO_X Analyzer Calibration Data By Modified Method 7E

Job No.	101494.1.004.02	Operator:	Daniel Neal
Client:	CCSI	Date:	17-Jul-00
Plant:	Gianera Generating Station		
Location:	Gas Turbine Outlet		

Analyzer Type:	Chemiluminescent	Analyzer Mfgr.:	Thermo Environmental Instr.
Zero Gas:	Prepurified nitrogen	Model No.	42H
Cal. Gas Mixture:	Nitrogen oxide in nitrogen	Serial No.	42H-41111-264

Analyzer Calibration Error Determination

Cal. No. NOX-1 Analyzer Span: 50 ppmv NO_X

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv NO_X	Calibration Gas Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv NO_X	Gas Value - Analyzer Response Difference As % of Span	Cal. Error Check Result[a]
19:45	Zero Gas	0.00	N/A	0.05	0.10%	Pass
19:54	High-range	44.90	ALM048090	44.97	0.14%	Pass
19:57	Mid-range	24.90	ALM048090	24.57	-0.66%	Pass

a. Calibration error check must not exceed ±2% of the span value.

Analyzer Drift

Calibration After M205 Injections Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv NO_X Before M205 Injections	Analyzer Response, ppmv NO_X After M205 Injections	Drift, % of Span	Drift Check Result[b]
20:26	Zero Gas	0.05	0.05	0.00%	Pass
20:30	Mid-range	24.57	24.51	-0.12%	Pass

b. Drift check must not exceed ±3% of the span value.

Analyzer Calibration Error Determination

Cal. No. NOX-2 Analyzer Span: 50 ppmv NO_X

Calibration Ending Time	Calibration Gas Concentration Level	Calibration Gas Value, ppmv NO_X	Calibration Gas Cylinder ID Number	Analyzer Response Value Following Calibration, ppmv NO_X	Gas Value - Analyzer Response Difference As % of Span	Cal. Error Check Result
19:45	Zero Gas	0.00	N/A	0.05	0.10%	Pass
19:54	High-range	44.90	ALM048090	44.97	0.14%	Pass
19:57	Mid-range	24.90	ALM048090	24.57	-0.66%	Pass

Analyzer Drift

Calibration After M205 Injections Ending Time	Calibration Gas Concentration Level	Analyzer Response, ppmv NO_X Before M205 Injections	Analyzer Response, ppmv NO_X After M205 Injections	Drift, % of Span	Drift Check Result
21:16	Zero Gas	0.05	0.04	-0.02%	Pass
21:20	Mid-range	24.57	24.24	-0.66%	Pass

Project No.: 101494.1.004.02

Date: 7/18/00

Corrective Action Report

Project Title/Description: ETV test of Catalytica Combustion System's XONON Flameless Combustion System

Description of Problem: When attempting to calibrate the NO_x analyzer for the Method 205 verification of the dilution system, the NO_x analyzer was non-linear.

Originator: Craig Clapsaddle Date: 7/17/00

Investigation and Results: After repeated attempts to make the response linear (by adjusting calibration settings), Dan Neal recalled that TECO told him to adjust the PMT (photo multiplier tube) if the calibration setpoint adjustments did not fix the problem.

Investigator: Craig Clapsaddle Date: 7/17/00

Corrective Action Taken: Adjustment of the PMT setpoint was made according to the manufacturer's instructions. The PMT setpoint was off and was adjusted. The ~~was~~ NO_x analyzer's response was linear and the Method 205 was successfully completed.

Originator: Craig Clapsaddle Date: 7/17/00

Reviewer: Daniel Neal Date: 7-18-00

cc: Project Leader, Program Manager, Division Manager, QA Unit

S/N2073

FLOW CONTROLLER CALIBRATION SHEET

Mf #: 1. Description: AIR , Size: 10000. SCCM, K-factor: 1.0

SERIAL # AW9502156

This flow controller was calibrated using a Sierra Cal Bench(TM), a traceable Primary Flow Standard Calibration System. This calibration is referenced to dry air at a temperature of 32°F (__C) and a pressure of 29.92 in.Hg (760Torr).

	Set Flow	True Flow
5 %	500.0 CCM	492.49 CCM
10 %	1000.0 CCM	993.99 CCM
20 %	2000.0 CCM	1993.1 CCM
30 %	3000.0 CCM	3001.5 CCM
40 %	4000.0 CCM	4013.9 CCM
50 %	5000.0 CCM	5023.3 CCM
60 %	6000.0 CCM	6044.5 CCM
70 %	7000.0 CCM	7049.0 CCM
80 %	8000.0 CCM	8093.5 CCM
90 %	9000.0 CCM	9096.6 CCM
100%	10000. CCM	10104. CCM

Calibration data was last saved on Tuesday 11 July 00 at 11:46:00

Verified by: Karl Sentiany Date: 7 - 11 - 00

FLOW CONTROLLER CALIBRATION SHEET

Mf #: 2, Description: AIR , Size: 10000. SCCM, K-factor: 1.0

SERIAL # AW9502157

This flow controller was calibrated using a Sierra Cal Bench(TM), a traceable Primary Flow Standard Calibration System. This calibration is referenced to dry air at a temperature of 32°F (__C) and a pressure of 29.92 in.Hg (760Torr).

	Set Flow	True Flow
5 %	500.0 CCM	497.4 CCM
10 %	1000.0 CCM	997.84 CCM
20 %	2000.0 CCM	1998.9 CCM
30 %	3000.0 CCM	3011.3 CCM
40 %	4000.0 CCM	4026.6 CCM
50 %	5000.0 CCM	5047.7 CCM
60 %	6000.0 CCM	6066.1 CCM
70 %	7000.0 CCM	7077.7 CCM
80 %	8000.0 CCM	8124.4 CCM
90 %	9000.0 CCM	9142.1 CCM
100%	10000. CCM	10158. CCM

Calibration data was last saved on Tuesday 11 July 00 at 11:48:00

Verified by: Karl Sentivany Date: 7 - 11 - 00

FLOW CONTROLLER CALIBRATION SHEET

Mf #: 3, Description: AIR , Size: 1000.0 SCCM, K-factor: 1.0

SERIAL # AW9502153

This flow controller was calibrated using a Sierra Cal Bench(TM), a traceable Primary Flow Standard Calibration System. This calibration is referenced to dry air at a temperature of 32°F (__C) and a pressure of 29.92 in.Hg (760Torr).

	Set Flow	True Flow
5 %	50.0 CCM	53.629 CCM
10 %	100.0 CCM	105.7 CCM
20 %	200.0 CCM	207.81 CCM
30 %	300.0 CCM	309.86 CCM
40 %	400.0 CCM	412.37 CCM
50 %	500.0 CCM	512.9 CCM
60 %	600.0 CCM	614.3 CCM
70 %	700.0 CCM	716.52 CCM
80 %	800.0 CCM	817.17 CCM
90 %	900.0 CCM	918.35 CCM
100%	1000.0 CCM	1020.3 CCM

Calibration data was last saved on Tuesday 11 July 00 at 12:57:00

Verified by: Karl Sontvany Date: 7 - 11 - 00

FLOW CONTROLLER CALIBRATION SHEET

Mf #: 4, Description: AIR , Size: 100.0 SCCM, K-factor: 1.0

SERIAL # AW9612049

This flow controller was calibrated using a Sierra Cal Bench(TM), a traceable Primary Flow Standard Calibration System. This calibration is referenced to dry air at a temperature of 32°F (__C) and a pressure of 29.92 in.Hg (760Torr).

	Set Flow	True Flow
5 %	5.0 CCM	5.111 CCM
10 %	10.0 CCM	10.254 CCM
20 %	20.0 CCM	20.567 CCM
30 %	30.0 CCM	30.68 CCM
40 %	40.0 CCM	41.01 CCM
50 %	50.0 CCM	50.852 CCM
60 %	60.0 CCM	61.185 CCM
70 %	70.0 CCM	71.366 CCM
80 %	80.0 CCM	81.508 CCM
90 %	90.0 CCM	91.794 CCM
100%	100.0 CCM	103.32 CCM

Calibration data was last saved on Thursday 16 December 99 at 14:43:00

Verified by: Karl Santiago Date: 12 - 16 - 00

NO_X Measurement System Interference Test

Operator: Daniel Neal
Date: 9-Jul-00
Analyzer Span: 20 ppmv NO_X

Analyzer Type: Chemiluminescent
Analyzer Manufacturer: Thermo Environmental Instr.
Model No. 42H
Serial No. 42H-41111-264

Measurement System Interference Determination

Test Gas		Analyzer Output Response, ppmv NO_X	Interference as % of Span
Component Tested	Component Concentration		
CO	498.04 ppmv	-0.03	-0.15%
SO_2	200.56 ppmv	0.09	0.45%
O_2	20.9 % by volume	-0.05	-0.25%
CO_2	9.984 % by volume	-0.06	-0.30%
		Total Interference as % of Span:	-0.25%
Sum of interferences must not exceed ±2% of span value.		Result:	Pass

O_2 Measurement System Interference Test

Operator: Daniel Neal
Date: 30-May-00
Analyzer Span: 25 $\%O_2$ by volume

Analyzer Type: Magnetopneumatic
Analyzer Manufacturer: Servomex
Model No. 01440CISTD
Serial No. 1391

Measurement System Interference Determination

Test Gas		Analyzer Output Response As $\%O_2$	Interference as % of Span
Component Tested	Component Concentration		
CO	498.17 ppmv	0.10	0.40%
SO_2	196.65 ppmv	0.00	0.00%
CO_2	9.984 % by volume	0.10	0.40%
		Total Interference as % of Span	0.80%
Sum of interferences must not exceed ±2% of span value.		Result:	Pass

CO_2 Measurement System Interference Test

Operator: Daniel Neal
Date: 30-May-00
Analyzer Span: 20 $\%CO_2$ by volume

Analyzer Type: single beam, dual wavelength IR
Analyzer Manufacturer: Servomex
Model No. 01440CISTD
Serial No. 1382

Measurement System Interference Determination

Test Gas		Analyzer Output Response As $\%CO_2$	Interference as % of Span
Component Tested	Component Concentration		
CO	498.17 ppmv	0.10	0.50%
SO_2	196.58 ppmv	0.10	0.50%
O_2	20.9 % by volume	0.10	0.50%
		Total Interference as % of Span:	1.50%
Sum of interferences must not exceed ±2% of span value.		Result:	Pass

CO Measurement System Interference Test

Operator: Daniel Neal
Date: 30-May-00
Analyzer Span: 100 ppmv CO

Analyzer Type: NDIRS with GFC
Analyzer Manufacturer: Thermo Environmental Instr.
Model No. 48
Serial No. 48-29095-233

Measurement System Interference Determination

Test Gas		Analyzer Output	Interference as % of Span
Component Tested	Component Concentration	Response, ppmv CO	
CO_2	9.984 % by volume	-1.80	-1.80%
Interference must not exceed ±2% of span value.		Result:	Pass

A.3 Letter Summarizing Results of Technical System Audit and Performance Evaluation

RESEARCH TRIANGLE INSTITUTE

Center for Environmental Measurements and Quality Assurance

October 17, 2000

Jack Balsinger
Senior Quality Assurance Officer
Midwest Research Institute
425 Volker Boulevard
Kansas City, Missouri 64110-2299

Mr. Balsinger,

Please find enclosed the final report of a performance evaluation (PE) and a technical systems audit (TSA) of Midwest Research Institute's (MRI's) verification test of Catalytica Combustion System's XONON flameless combustion system at Silicon Valley Power's Gianera Generating Station in Santa Clara, California. These technical assessments were performed by Robert S. Wright of Research Triangle Institute (RTI) and Michael W. Tufts of ARCADIS Geraghty & Miller on July 17-18, 2000.

The verification testing was performed as part of the U.S. EPA's Environmental Technology Verification (ETV) Program. Under EPA Cooperative Agreement CR 826152-01-0, RTI is the prime contractor and MRI is a subcontractor in a ETV pilot project for the verification testing of air pollution control technologies. EPA's *Environmental Technology Verification Program Quality and Management Plan for the Pilot Period (1995-2000)* specifies that PEs are to be conducted, as applicable, for each test as provided in the test/quality assurance (QA) plan and that TSAs are to be conducted for each test as provided for in the project's test/QA plan.

The purpose of the PE and the TSA was to conduct an independent and objective technical assessment of the verification test through an in-depth evaluation of quality system documents, on-site activities, equipment, procedures, and record keeping to assure (1) that environmental data collection activities and related results comply with the project's test/QA plan and other quality system documents; (2) that these activities are implemented effectively; and (3) that these activities are suitable to achieve the project's data quality goals. These technical assessments were conducted in accordance with auditing principles and procedures in *EPA Guidance for Technical Assessments for Environmental Data Operations* (EPA Publication No. EPA QA/G-7, 2000). The basis for the TSA was MRI's *Test/QA Plan for the Verification Testing of Catalytica Combustion System, Inc. XONON Flameless Combustion System (Revision 1, July 5, 2000).*

In general, Mr. Tufts and I found that MRI was doing a good job of testing the XONON technology. We found no deficiencies that would adversely impact the quality of results and that could have required stopping the test until they were corrected. The testing was executed according to the test/QA plan with only minor deviations. The equipment was appropriate for the testing and it was operating satisfactorily. The project personnel were well-qualified to perform the testing and conducted themselves in a professional manner. They cooperated with

us during the TSA and the PE and took time out from their busy duties to explain to us what was happening. They helped to ensure the successful completion of the technical assessments.

A report on the results of the PE is attached to this letter. Because the only critical measurement for the verification test was the nitrogen oxides (NO_X) measurements by EPA Method 20, the PE involved only the continuous NO_X emissions monitor that MRI used during the test. The PE was performed using a compressed gas calibration standard, which was certified by its producer to contain 1.00 parts per million (ppm) of NO_X in nitrogen. This concentration approximates typical NO_X emissions levels for the XONON technology. The average response of the analyzer to the PE sample was 0.992 ppm during the morning of July 18 and 0.990 ppm during the afternoon. These responses differed by -0.8 percent and -1.0 percent, respectively, from the standard's certified concentration. They are well within the +/- 50 percent acceptance criterion that was established informally for the NO_X analyzer accuracy prior to the verification test.

The remainder of this letter summarizes TSA findings in which conditions appear to be different from the test/QA plan or in which some uncertainty exists. These conditions are unlikely to have a significant effect on data quality. They are numbered by the TSA checklist section where the question appears. The full completed checklist is attached to this letter.

Section	**Findings about conditions, which do not have an significant effect on data quality.**
A4	Two minor deviations from the test/QA plan were found. NO_X sampling probe traverses were performed in fewer directions than specified in the test/QA plan because of scaffolding limitations. The balance gas for one calibration standard was nitrogen, rather than air. Neither deviation effects data quality.
D4	The test/QA plan documents a data quality objective for the variability of the NO_X emission concentrations, which is the critical measurement in the verification test. It did not specify measurement performance criteria for the accuracy, precision, and completeness of the EPA Method 20, which is used to determine the NO_X emission concentrations. This omission in the plan is not a deficiency, but it produced some uncertainty regarding the acceptance criterion for the performance evaluation, which was established informally prior to the performance evaluation by RTI and MRI staff.
H19, Comments for Section H	The EPA Method 205 field evaluation was conducted on the NO_X analyzer's 50-ppm range, rather than the specified 20-ppm operating range, because of a questionable 9.92 ppm nitric oxide (NO) check standard that MRI had wanted to use on the 20-ppm range. There is something of a mystery surrounding the check standard. It was returned to the specialty gas producer for reanalysis because it produced questionable results before the test began. The recertified NO concentration was close to the original certified value. On July 18, Catalytica's NO_X analyzer measured the check standard and found it to contain 10.0 ppm, but MRI's NO_X measurement of the check standard on the same day found it to contain 9.40 ppm. Yet both analyzers produced very similar results (i.e., 1.0 ppm and 0.99 ppm, respectively) for EPA's 1.00 ppm NO_X performance evaluation sample. The discrepancy in the measured concentration of the check standard has not been resolved, but it probably does not effect on the quality of the NO_X measurements.

Please contact me at 541-6263 or rsw@rti.org if you have any questions concerning the final report or the technical assesments.

Respectfully,

Robert S. Wright,
Environmental Scientist

file: 93U-07012-032

cc: Paul Groff, EPA
Ted Brna, EPA
Craig Clapsaddle, MRI
Drew Trenholm, MRI
Jack Farmer, RTI
Doug VanOsdell, RTI
Mike Tufts, ARCADIS

APPENDIX B

Raw Test Data

B.1 Raw Concentration Printouts from Labtech Notebook

B.2 Raw Data – Ambient Conditions

B.3 Emission Concentration Summaries

B.4 Turbine Process Data

B.1 Raw Concentration Printouts from Labtech Notebook

Test Events Log Runs 1 - 3

Job No.	101494.1.004.02	Operator:	Daniel Neal
Client:	CCSI	Date:	18-Jul-00
Plant:	Gianera Generating Station		
Location:	Gas Turbine Outlet		

4:43	Send N_2 direct to all analyzers
4:50	Set Zero on the CO analyzer
4:50	Send High CO directly to all analyzers
4:58	Set High CO Calibration
4:58	Send Mid CO directly to all analyzers
5:01	Record Mid CO reading
5:01	Send Low CO directly to all analyzers
5:04	Record Low CO reading
5:04	Send N2 to the system
5:18	Set Zero on O_2, CO_2, and NO_X analyzers, record CO zero
5:20	Send Mid O_2 to system
5:29	Set Mid O_2 on O_2 analyzer
5:29	Send High O_2 to system
5:31	Record High O_2 reading on the O_2 analyzer
5:31	Send Mid CO_2 to system
5:35	Set Mid CO_2 on CO_2 analyzer
5:35	Send High CO_2 to system
5:38	Record High CO_2 reading on the CO_2 analyzer
5:40	Send Mid NO to the system
5:50	Set Mid NO on NO_X analyzer
5:50	Send High NO to system, change analyzer to Manual Mode
5:53	Record High NO reading on the NO_X analyzer
5:55	Send Low NO to the system
5:58	Record Low NO reading on the NO_X analyzer
5:58	Send Mid CO to system
6:01	Record Mid CO reading on the CO analyzer
6:30	Send Zero gas to THC system
6:32	Set Zero on the THC analyzer
6:32	Send High THC to THC system
6:38	Set High on the THC analyzer
6:38	Send Mid THC to THC system
6:41	Record Mid THC reading on the THC analyzer
6:41	Send Low THC to THC system
6:44	Record Low THC reading on the THC analyzer
6:50	Turn to "Sample" and set probe at 1st sampling point
7:00	Start Run 1
7:32	End Run 1
7:33	Send N_2 thru the system to all analyzers
7:37	Record O2 zero
7:36	Record CO2 zero
7:37	Record Nox zero
7:37	Record CO zero
7:39	Send Mid O2 to system
7:42	Record Mid O2 reading on the O2 analyzer
7:43	Send Mid CO2 to system
7:45	Record Mid CO2 reading on the CO2 analyzer

7:45 Send Mid NOx to system
7:50 Record Mid NOx reading on the NOx analyzer
7:50 Send Mid CO to system
7:54 Record Mid CO reading on the CO analyzer
7:55 Send zero to THC system
7:58 Record zero THC reading on the THC analyzer
7:58 Send Mid THC to system
8:01 Record Mid THC reading on the THC analyzer

8:10 Start Run 2
8:42 End Run 2

8:45 Send N_2 thru the system to all analyzers
8:48 Record O2 zero
8:50 Record CO2 zero
8:48 Record Nox zero
8:48 Record CO zero
8:51 Send Mid O2 to system
8:53 Record Mid O2 reading on the O2 analyzer
8:54 Send Mid CO2 to system
8:56 Record Mid CO2 reading on the CO2 analyzer
8:57 Send Mid NOx to system
9:01 Record Mid NOx reading on the NOx analyzer
9:02 Send Mid CO to system
9:06 Record Mid CO reading on the CO analyzer
9:07 Send zero to THC system
9:10 Record zero THC reading on the THC analyzer
9:13 Send Mid THC to system
9:17 Record Mid THC reading on the THC analyzer

9:20 Start Run 3
9:52 End Run 3

9:52 Send N_2 thru the system to all analyzers
9:56 Record O2 zero
9:56 Record CO2 zero
9:55 Record Nox zero
9:56 Record CO zero
9:58 Send Mid O2 to system
10:00 Record Mid O2 reading on the O2 analyzer
10:00 Send Mid CO2 to system
10:03 Record Mid CO2 reading on the CO2 analyzer
10:03 Send Mid NOx to system
10:07 Record Mid NOx reading on the NOx analyzer
10:07 Send Mid CO to system
10:10 Record Mid CO reading on the CO analyzer
10:12 Send zero to THC system
10:16 Record zero THC reading on the THC analyzer
10:16 Send Mid THC to system
10:18 Record Mid THC reading on the THC analyzer

ETV/RTI Verification Test
Runs 1 - 3
Time is 04:33:50.63.
Date is 7-18-2000.

Time	CO	O2	CO2	TGOC	NOx
	ppm	%	%	ppm	ppm
4:33	-0.24	0.12	0.1	1.66	-0.03
4:34	-0.2	0.35	0.18	1.66	-0.04
4:35	-0.25	0.29	0.16	1.65	-0.04
4:36	-0.1	0.26	0.18	1.64	-0.03
4:37	0.35	0.32	0.03	1.63	-0.03
4:38	0.07	0.31	-0.05	1.66	-0.03
4:39	-0.12	0.31	-0.05	1.68	-0.02
4:40	-0.23	0.33	-0.02	1.66	-0.03
4:41	-0.01	0.3	-0.04	1.66	-0.03
4:42	-0.07	0.29	-0.06	1.66	-0.02
4:43	-0.09	0.31	-0.02	1.64	-0.03
4:44	-0.07	0.26	0.13	1.66	-0.04
4:45	3.28	0.26	0.18	1.61	-0.04
4:46	0.52	0.26	0.16	1.65	-0.04
4:47	0.49	0.26	0.16	1.79	-0.04
4:48	0.23	0.24	0.17	1.82	-0.04
4:49	0.19	0.24	0.2	1.76	-0.04
4:50	0.07	0.27	0.1	1.74	-0.04
4:51	0.21	0.29	-0.05	1.78	-0.03
4:52	0.27	0.18	-0.05	1.94	8.59
4:53	1.2	0.3	-0.04	1.7	11.71
4:54	39.9	0.32	-0.04	1.62	0.01
4:55	46.04	0.33	-0.07	1.62	-0.01
4:56	45.42	0.33	-0.07	1.62	-0.03
4:57	45.1	0.27	0.14	1.58	-0.04
4:58	45.13	0.27	0.14	1.6	-0.04
4:59	46.22	0.24	0.21	1.63	0.04
5:00	33.15	0.26	0.18	1.59	-0.04
5:01	30.03	0.25	0.18	1.6	-0.04
5:02	33.27	0.16	0.19	1.58	-0.02
5:03	15.64	0.27	0.13	1.61	-0.03
5:04	15.01	0.29	-0.02	1.63	-0.03
5:05	17.11	3.91	-0.05	1.65	-0.02
5:06	2.19	0.33	-0.06	1.95	-0.02
5:07	0.11	0.33	-0.07	2.21	-0.03
5:08	0.15	0.35	-0.06	2.24	-0.03
5:09	0.09	0.25	-0.06	1.9	-0.02
5:10	0.03	0.11	0.16	1.66	-0.04
5:11	0	0.04	0.22	1.71	-0.03
5:12	0.15	0.04	0.22	1.64	-0.04
5:13	0.03	0.02	0.25	1.61	-0.06
5:14	0.15	0.04	0.21	1.62	-0.06
5:15	0.07	0.05	0.19	1.69	-0.06
5:16	0.22	0.05	0.11	1.74	-0.06
5:17	0.14	0.08	-0.04	1.69	-0.05
5:18	0.22	0.13	-0.04	1.74	-0.05
5:19	0.13	5.09	-0.07	1.72	-0.05
5:20	0.2	19.37	-0.07	1.69	-0.05
5:21	0.83	12	-0.08	1.62	-0.05
5:22	0.08	12.2	-0.07	1.57	-0.05
5:23	-0.02	12.15	0.04	1.59	-0.05
5:24	-0.04	12.16	0.14	1.72	-0.06
5:25	-0.01	12.15	0.16	1.7	-0.06
5:26	0	12.09	0.15	1.66	-0.06
5:27	-0.02	12.08	0.19	1.59	-0.06
5:28	0.01	12.06	0.16	1.75	-0.06
5:29	-0.03	12.06	0.15	1.87	-0.06
5:30	0.16	17.48	-0.04	1.97	-0.05
5:31	-0.02	21.05	-0.05	2.21	-0.05
5:32	0.07	14.92	0.58	2.18	-0.05

5:33	0.16	0.18	3.05	1.79	-0.05
5:34	-0.05	0.14	3.05	1.92	-0.05
5:35	-0.14	0.14	3.08	2.15	-0.05
5:36	-0.01	4.05	5.11	2.03	-0.05
5:37	-0.46	-0.06	10.31	1.91	-0.06
5:38	-0.48	-0.06	10.35	2.01	-0.06
5:39	-0.44	4.54	7.97	2.1	-0.06
5:40	-0.1	19.48	0.66	2.03	-0.06
5:41	-0.05	0.99	0.49	2.04	-0.06
5:42	0.15	0.09	0.22	1.93	5.1
5:43	0.17	0.12	0.03	1.96	14.38
5:44	0.09	0.12	-0.06	1.84	9.67
5:45	0.09	0.14	-0.05	2.1	10.01
5:46	0.17	0.12	-0.05	1.61	10
5:47	0.21	0.12	-0.05	1.62	9.95
5:48	0.12	0.11	-0.09	1.59	9.96
5:49	0.07	0.12	-0.07	1.5	10.01
5:50	0.01	0.07	0.12	1.43	10.03
5:51	0.02	4.44	0.18	1.49	8.92
5:52	0.02	0.05	0.14	1.52	16.78
5:53	0.05	0.04	0.14	1.55	17.14
5:54	0.07	2.12	0.16	1.97	13.64
5:55	0.04	10.75	0.2	1.95	3.91
5:56	0	2.74	0.12	1.87	7.27
5:57	0.11	0.14	-0.03	2.11	4.95
5:58	0.11	0.13	-0.06	1.82	4.94
5:59	2.51	4.18	-0.04	1.67	5.82
6:00	27.87	0.15	-0.07	1.84	0.7
6:01	29.79	0.14	-0.04	1.86	0.05
6:02	29.78	0.13	-0.07	1.55	0.03
6:03	16.54	15.33	0.13	1.51	0.06
6:04	0.7	16.2	0.19	1.49	0.09
6:05	25.76	0.14	0.12	1.95	0.08
6:06	19.45	10.43	2.24	2.09	0.39
6:07	1.05	15.36	3.15	2.49	1.18
6:08	2.14	6.72	1.4	1.67	0.81
6:09	0.95	10.38	2.15	2	0.77
6:10	0.39	5.43	0.99	2.45	0.41
6:11	0.54	6.87	1.24	2.03	0.54
6:12	0.41	10.25	1.96	2.58	0.77
6:13	0.26	0.19	-0.06	2.36	0.05
6:14	0.35	10.78	2.06	2.38	0.75
6:15	0.88	15.42	2.93	2.35	1.08
6:16	0.84	9.77	1.92	2.27	0.72
6:17	0.08	0.14	0.16	2.97	0.05
6:18	0.46	11.53	2.44	1.83	0.76
6:19	0.94	7.17	1.53	2.15	0.52
6:20	0.38	8.82	1.91	1.85	0.61
6:21	0.55	6.72	1.43	1.95	0.51
6:22	0.27	8.88	1.94	1.82	0.62
6:23	0.89	15.42	2.99	2.66	1.04
6:24	0.92	15.46	2.92	2.42	1.03
6:25	1.01	15.46	2.93	2.27	1.03
6:26	1	15.47	2.94	1.88	1.03
6:27	0.96	15.48	2.94	1.93	1.04
6:28	1.04	15.46	2.92	2.73	1.04
6:29	1.22	15.49	2.96	2.8	1.04
6:30	1.38	15.43	3.16	1.27	1.04
6:31	0.95	15.39	3.18	-0.01	1.09
6:32	0.64	15.41	3.19	-0.02	1.07
6:33	0.88	15.43	3.17	60.72	1.07
6:34	0.98	15.42	3.17	90.3	1.06
6:35	0.96	15.42	3.18	84.98	1.05
6:36	1.05	15.45	3.1	85.07	1.06
6:37	1	15.48	2.99	85.11	1.06
6:38	1.24	15.48	2.96	85.07	1.05

6:39	1.27	15.49	2.96	66.06	1.05
6:40	1.35	15.47	2.97	50.06	1.06
6:41	0.74	15.48	2.93	49.99	1.1
6:42	0.95	15.49	2.95	39.19	1.07
6:43	1.01	15.44	3.07	29.96	1.05
6:44	0.99	15.43	3.15	29.89	1.03
6:45	0.9	15.42	3.14	23.05	1.04
6:46	1	15.41	3.15	22	1.03
6:47	0.94	15.43	3.17	17.74	1.03
6:48	1.19	15.43	3.16	45.16	1.03
6:49	1.21	15.42	3.16	50.68	1.02
6:50	1.25	15.48	2.97	40.38	1.05
6:51	0.8	15.47	2.97	1.05	1.09
6:52	0.89	15.47	2.99	0.86	1.06
6:53	0.98	15.49	2.93	1.28	1.05
6:54	1.01	15.49	2.95	1.11	1.04
6:55	1	15.49	2.95	1.13	1.04
6:56	1	15.46	3.03	1.12	1.03
6:57	1	15.42	3.19	1.16	1.04
6:58	1.16	15.43	3.17	0.35	1.03
6:59	1.21	15.42	3.16	0.37	1.04
7:00	0.94	15.42	3.16	0.48	1.09
7:01	0.59	15.44	3.16	0.29	1.1
7:02	0.92	15.42	3.17	0.24	1.07
7:03	0.96	15.46	3	0.22	1.07
7:04	0.93	15.49	2.94	0.21	1.05
7:05	1.16	15.49	2.94	0.19	1.05
7:06	1.2	15.48	2.92	0.2	1.06
7:07	1.18	15.47	2.93	0.2	1.06
7:08	1.38	15.49	2.94	0.18	1.07
7:09	1.16	15.49	2.94	0.18	1.11
7:10	0.68	15.45	3.14	0.13	1.11
7:11	0.94	15.39	3.16	0.14	1.1
7:12	0.95	15.43	3.19	0.12	1.09
7:13	0.98	15.41	3.19	0.14	1.09
7:14	1.02	15.44	3.17	0.1	1.06
7:15	1.17	15.43	3.17	0.09	1.05
7:16	1.13	15.43	3.11	0.12	1.03
7:17	1.43	15.48	2.99	0.13	1.04
7:18	1.25	15.47	2.97	0.13	1.08
7:19	0.71	15.49	2.96	0.12	1.09
7:20	1.01	15.48	2.96	0.12	1.06
7:21	1.09	15.5	2.95	0.13	1.05
7:22	1.15	15.48	2.95	0.12	1.05
7:23	1.18	15.45	3.07	0.11	1.05
7:24	1.54	15.41	3.15	0.09	1.06
7:25	1.43	15.41	3.15	0.09	1.05
7:26	1.52	15.42	3.15	-0.11	1.07
7:27	0.91	15.44	3.14	0.09	1.12
7:28	0.89	15.44	3.17	0.09	1.11
7:29	0.98	15.41	3.15	0.1	1.11
7:30	1.27	15.49	2.98	0.11	1.09
7:31	1.36	15.49	2.95	0.1	1.09
7:32	1.4	15.49	2.93	0.11	1.07
7:33	1.6	15.49	2.97	0.11	1.06
7:34	1.78	13.15	2.42	0.1	0.92
7:35	0.43	0.25	-0.06	0.1	0.07
7:36	0.1	0.2	-0.03	0.1	0.05
7:37	0	0.11	0.14	0.09	0.04
7:38	0.07	0.09	0.19	-0.25	0.03
7:39	0.02	0.1	0.16	-0.19	0.02
7:40	0.06	3.31	0.83	0.06	0.22
7:41	0.82	12.41	1.07	0.07	0.35
7:42	-0.34	11.99	0.15	0.09	0.02
7:43	-0.04	12.75	0.73	0.09	0.24
7:44	0.4	2.32	2.99	0.09	0.22

7:45	0.15	0.14	3.06	0.09	0.03
7:46	0.06	4.48	3.04	0.09	0.3
7:47	0.53	1.76	0.57	0.11	7.58
7:48	0.12	0.18	-0.07	0.11	9.65
7:49	-0.2	0.17	-0.08	0.1	10.08
7:50	0.02	0.09	0.06	0.09	10.03
7:51	0.04	2.45	0.63	0.07	8.53
7:52	17.47	0.72	0.27	0.09	1.06
7:53	29.55	0.11	0.13	0.09	0.07
7:54	29.57	0.08	0.15	0.08	0.04
7:55	29.32	2.02	0.56	0.36	0.16
7:56	7.28	15.33	3.16	3.29	1.08
7:57	1.96	15.45	2.95	-0.08	1.13
7:58	1.35	15.43	2.93	-0.06	1.18
7:59	1.05	15.48	2.97	24.87	1.15
8:00	1.49	15.49	2.95	49.81	1.12
8:01	1.39	15.47	2.93	49.9	1.1
8:02	1.48	15.48	2.92	19.01	1.08
8:03	1.51	15.49	3.01	0.2	1.06
8:04	1.69	15.42	3.19	0.14	1.05
8:05	1.77	15.42	3.17	0.12	1.04
8:06	1.26	15.43	3.16	0.1	1.11
8:07	1.03	15.43	3.17	0.1	1.11
8:08	1.26	15.42	3.17	0.1	1.07
8:09	1.36	15.44	3.19	0.09	1.06
8:10	1.39	15.49	3.05	0.1	1.07
8:11	1.75	15.52	2.94	0.11	1.05
8:12	1.9	15.5	2.9	0.13	1.04
8:13	1.86	15.49	2.91	0.12	1.04
8:14	0.99	15.49	2.91	0.12	1.1
8:15	1.09	15.51	2.92	0.11	1.06
8:16	1.38	15.53	2.94	0.09	1.05
8:17	1.41	15.44	3.11	0.09	1.06
8:18	1.44	15.45	3.14	0.1	1.06
8:19	1.56	15.44	3.14	0.1	1.05
8:20	1.87	15.43	3.16	0.07	1.06
8:21	1.89	15.44	3.15	0.09	1.09
8:22	1.03	15.44	3.14	0.08	1.12
8:23	1.16	15.46	3.14	0.06	1.09
8:24	1.5	15.51	2.91	0.11	1.08
8:25	1.62	15.52	2.95	0.09	1.04
8:26	1.76	15.54	2.95	0.09	1.04
8:27	1.7	15.51	2.93	0.1	1.05
8:28	1.94	15.49	2.92	0.1	1.05
8:29	1.88	15.51	2.93	0.1	1.09
8:30	1.07	15.51	3.01	0.08	1.1
8:31	1.35	15.44	3.19	0.07	1.06
8:32	1.44	15.46	3.17	0.07	1.05
8:33	1.58	15.45	3.17	0.07	1.04
8:34	1.54	15.47	3.17	0.07	1.04
8:35	1.82	15.47	3.17	0.05	1.04
8:36	1.93	15.43	3.18	0.06	1.05
8:37	1.81	15.47	3.07	0.08	1.11
8:38	0.98	15.52	2.94	0.09	1.14
8:39	1.44	15.52	2.94	0.09	1.1
8:40	1.47	15.53	2.95	0.1	1.09
8:41	1.58	15.53	2.95	0.09	1.07
8:42	1.47	15.49	2.96	0.1	1.06
8:43	1.77	15.53	2.92	0.1	1.05
8:44	1.9	15.47	3.11	0.08	1.04
8:45	2.32	5.43	1.14	0.08	0.48
8:46	0.05	0.17	0.15	0.07	0.05
8:47	-0.04	0.15	0.2	0.07	0.04
8:48	0	0.11	0.15	0.08	0.04
8:49	0.02	0.11	0.14	0.06	0.03
8:50	0.02	0.12	0.12	0.06	0.02

8:51	0.01	0.16	-0.07	0.1	0.03
8:52	0.33	7.56	1.32	0.08	0.47
8:53	0.52	11.98	-0.04	0.07	0.03
8:54	0.07	12.66	0.46	0.09	0.19
8:55	0.92	10.85	2.68	0.1	0.86
8:56	0.22	0.22	3.06	0.09	0.05
8:57	-0.07	2.15	3.11	0.07	0.16
8:58	0.85	7.15	1.96	0.07	4.47
8:59	0.08	0.14	0.14	0.07	9.5
9:00	0.01	0.13	0.13	0.06	9.89
9:01	0	0.11	0.12	0.09	9.92
9:02	0.04	0.1	0.12	0.06	9.84
9:03	0.82	13.42	2.81	0.07	2.31
9:04	18.29	0.36	0.07	0.09	1.2
9:05	29.4	0.21	-0.08	0.09	0.11
9:06	29.55	0.21	-0.11	0.1	0.08
9:07	29.44	0.19	-0.09	0.09	0.06
9:08	14.46	13.43	2.55	2.27	0.89
9:09	1.15	15.46	2.91	-0.1	1.09
9:10	1.18	15.49	2.89	-0.07	1.07
9:11	1.29	15.45	3.06	-0.09	1.05
9:12	1.32	15.46	3.14	-0.13	1.03
9:13	1.45	15.47	3.14	-0.14	1.02
9:14	1.64	15.46	3.14	17.56	1
9:15	1.79	15.47	3.16	49.34	1.01
9:16	1.48	15.46	3.15	49.47	1.05
9:17	0.93	15.48	3.14	49.49	1.07
9:18	1.33	15.52	2.94	18.28	1.03
9:19	1.27	15.52	2.91	0.23	1.02
9:20	1.4	15.55	2.94	0.15	1.01
9:21	1.64	15.54	2.93	0.14	1
9:22	1.57	15.52	2.89	0.15	1
9:23	1.78	15.54	2.92	0.13	0.99
9:24	1.51	15.54	2.95	0.1	1.03
9:25	0.83	15.48	3.14	0.09	1.03
9:26	1.39	15.47	3.15	0.09	1.01
9:27	1.4	15.45	3.17	0.12	0.99
9:28	1.37	15.46	3.15	0.12	0.98
9:29	1.54	15.47	3.16	0.13	1
9:30	1.62	15.45	3.15	0.13	1
9:31	1.86	15.49	3.09	0.14	1.03
9:32	1.65	15.49	2.93	0.17	1.07
9:33	0.79	15.55	2.95	0.15	1.08
9:34	1.41	15.52	2.9	0.17	1.04
9:35	1.52	15.56	2.92	0.15	1.01
9:36	1.54	15.52	2.9	0.18	1
9:37	1.44	15.55	2.89	0.18	1
9:38	1.34	15.51	3.04	0.16	0.98
9:39	1.56	15.48	3.16	0.12	0.98
9:40	1.45	15.49	3.16	0.11	0.99
9:41	0.59	15.46	3.16	0.12	1.04
9:42	1.28	15.49	3.16	0.11	1.01
9:43	0.98	15.45	3.16	0.14	1.01
9:44	1.09	15.45	3.19	0.14	1.01
9:45	1.17	15.52	3.04	0.15	1.02
9:46	1.33	15.52	2.94	0.16	1.02
9:47	1.25	15.54	2.93	0.16	1.02
9:48	1.6	15.54	2.94	0.14	1.02
9:49	0.91	15.54	2.93	0.15	1.06
9:50	0.82	15.53	2.96	0.15	1.03
9:51	0.9	15.54	2.92	0.15	1.01
9:52	1.09	15.47	3.11	0.14	1
9:53	1.08	14.14	2.85	0.14	0.98
9:54	1.48	0.27	0.16	0.14	0.07
9:55	-0.08	0.17	0.17	0.14	0.04
9:56	-0.07	0.14	0.16	0.14	0.04

9:57	-0.1	0.14	0.15	0.14	0.03
9:58	-0.02	0.12	0.13	0.15	0.02
9:59	0.07	7.46	0.14	0.17	0.1
10:00	-0.1	12.06	-0.06	0.18	0.03
10:01	0.05	13.29	1.06	0.17	0.36
10:02	0.84	10.65	2.87	0.19	0.77
10:03	-0.01	0.2	3.07	0.19	0.05
10:04	0.22	7.39	3.07	0.2	0.5
10:05	0.42	0.58	0.22	0.2	8.71
10:06	0	0.11	0.17	0.17	9.56
10:07	-0.08	0.11	0.15	0.18	9.86
10:08	0.04	4.53	1.15	0.19	6.81
10:09	21.41	0.18	0.14	0.17	0.14
10:10	29.39	0.13	0.15	0.17	0.07
10:11	29.26	0.11	0.16	0.18	0.05
10:12	29.41	0.15	0.05	0.2	0.05
10:13	17.28	12.01	2.28	1.53	0.85
10:14	1.22	15.45	2.92	0.89	1.06
10:15	0.79	15.5	2.91	0.03	1.08
10:16	0.92	15.51	2.9	0.02	1.05
10:17	1.01	15.5	2.92	26.1	1.04
10:18	1.02	15.54	2.9	49.48	1.04
10:19	1.03	15.48	3.1	29.93	1.04
10:20	1.23	15.47	3.14	0.37	1.02
10:21	1.3	15.48	3.14	0.28	1.02
10:22	1.09	15.47	3.15	0.23	1.05
10:23	0.72	15.48	3.15	0.21	1.06
10:24	0.93	15.47	3.15	0.21	1.02
10:25	0.91	15.5	3.14	0.2	1
10:26	1.06	12.71	2.32	0.21	1.03
10:27	0.37	0.3	-0.08	0.21	1.02
10:28	-0.09	0.22	-0.06	0.22	1.02
10:29	-0.13	0.24	-0.07	0.2	0.99
10:30	-0.09	0.21	-0.08	0.22	0.99
10:31	-0.04	0.2	-0.06	0.19	0.98
10:32	-0.12	0.15	-0.02	0.21	0.98
10:33	-0.08	4.54	1.1	0.15	0.95
10:34	0.81	15.36	3.18	0.16	0.94
10:35	0.42	6.13	1.29	0.16	6.03
10:36	-0.28	0.15	0.14	0.19	9.4
10:37	-0.15	0.15	0.15	0.16	9.4
10:38	-0.16	0.13	0.18	0.15	9.4
10:39	-0.13	0.17	0.04	0.17	9.41
10:40	-0.08	4.26	0.81	0.2	6.9
10:41	0.83	15.39	2.89	0.19	0.99
10:42	0.89	15.5	2.93	0.2	0.98

Test Events Log Runs 4 - 6

Job No.	101494.1.004.02	Operator:	Daniel Neal
Client:	CCSI	Date:	18-Jul-00
Plant:	Gianera Generating Station		
Location:	Gas Turbine Outlet		

14:54	Send N_2 direct to all analyzers
15:01	Set Zero on the CO analyzer
15:01	Send High CO directly to all analyzers
15:06	Set High CO Calibration
15:06	Send Mid CO directly to all analyzers
15:10	Record Mid CO reading
15:10	Send Low CO directly to all analyzers
15:14	Record Low CO reading
15:14	Send N2 to the system
15:20	Set Zero on O_2, CO_2, and NO_X analyzers, record CO zero
15:20	Send Mid O_2 to system
15:22	Set Mid O_2 on O_2 analyzer
15:22	Send High O_2 to system
15:25	Record High O_2 reading on the O_2 analyzer
15:25	Send Mid CO_2 to system
15:35	Set Mid CO_2 on CO_2 analyzer
15:35	Send High CO_2 to system
15:38	Record High CO_2 reading on the CO_2 analyzer
15:38	Send Mid NO to the system
15:46	Set Mid NO on NO_X analyzer
15:47	Send High NO to system, change analyzer to Manual Mode
15:50	Record High NO reading on the NO_X analyzer
15:50	Send Low NO to the system
15:53	Record Low NO reading on the NO_X analyzer
15:53	Send zero gas to system for CO
15:58	Record zero CO reading on the CO analyzer
16:01	Send Mid CO to system
16:05	Record Mid CO reading on the CO analyzer
16:05	Send Zero gas to THC system
16:13	Set Zero on the THC analyzer
16:14	Send High THC to THC system
16:17	Set High on the THC analyzer
16:17	Send Mid THC to THC system
16:20	Record Mid THC reading on the THC analyzer
16:20	Send Low THC to THC system
16:24	Record Low THC reading on the THC analyzer
16:24	Turn to "Sample" and set probe at 1st sampling point
16:40	Start Run 4
17:12	End Run 4
17:15	Send N_2 thru the system to all analyzers
17:18	Record O2 zero
17:18	Record CO2 zero
17:18	Record Nox zero
17:19	Record CO zero
17:21	Send Mid O2 to system

ETV RTI Runs 4 - 6 7/18/00 10:34 PM

17:23 Record Mid O2 reading on the O2 analyzer
17:23 Send Mid CO2 to system
17:26 Record Mid CO2 reading on the CO2 analyzer
17:28 Send Mid NOx to system
17:32 Record Mid NOx reading on the NOx analyzer
17:32 Send Mid CO to system
17:37 Record Mid CO reading on the CO analyzer
17:37 Send zero to THC system
17:40 Record zero THC reading on the THC analyzer
17:40 Send Mid THC to system
17:43 Record Mid THC reading on the THC analyzer

17:50 Start Run 5
18:22 End Run 5

18:24 Send N_2 thru the system to all analyzers
18:28 Record O2 zero
18:28 Record CO2 zero
18:28 Record Nox zero
18:29 Record CO zero
18:30 Send Mid O2 to system
18:34 Record Mid O2 reading on the O2 analyzer
18:34 Send Mid CO2 to system
18:37 Record Mid CO2 reading on the CO2 analyzer
18:37 Send Mid NOx to system
18:41 Record Mid NOx reading on the NOx analyzer
18:41 Send Mid CO to system
18:45 Record Mid CO reading on the CO analyzer
18:47 Send zero to THC system
18:51 Record zero THC reading on the THC analyzer
18:51 Send Mid THC to system
18:54 Record Mid THC reading on the THC analyzer

18:58 Start Run 6
19:30 End Run 6

19:32 Send N_2 thru the system to all analyzers
19:35 Record O2 zero
19:35 Record CO2 zero
19:35 Record Nox zero
19:36 Record CO zero
19:36 Send Mid O2 to system
19:39 Record Mid O2 reading on the O2 analyzer.
19:39 Send Mid CO2 to system
19:42 Record Mid CO2 reading on the CO2 analyzer
19:43 Send Mid NOx to system
19:47 Record Mid NOx reading on the NOx analyzer
19:47 Send Mid CO to system
19:52 Record Mid CO reading on the CO analyzer
19:52 Send zero to THC system
19:56 Record zero THC reading on the THC analyzer
19:56 Send Mid THC to system
20:00 Record Mid THC reading on the THC analyzer

ETV/RTI Verification Test
1st Day PM Test
Time is 14:50:05.04.
Date is 7-18-2000.

Time	CO	O2	CO2	TGOC	NOx
	ppm	%	%	ppm	ppm
14:50	0	0.24	0.1	0.24	0
14:51	-0.02	0.21	0.14	0.25	0
14:52	0.37	0.16	0.15	0.24	0
14:53	0.15	0.17	0.14	0.22	0
14:54	-0.03	0.17	0.13	0.22	0
14:55	0.46	4.86	0.85	0.25	0.32
14:56	0.22	0.21	-0.06	0.3	0.01
14:57	0.13	0.19	-0.05	0.33	0.01
14:58	0.05	0.21	-0.07	0.28	0.01
14:59	-0.07	0.2	-0.08	0.26	0.01
15:00	0.07	0.19	-0.09	0.24	0.01
15:01	-0.07	0.15	0.02	0.23	0.01
15:02	12.94	0.12	0.13	0.21	0.02
15:03	44.33	0.17	0.13	0.19	0
15:04	44.71	0.17	0.13	0.19	0
15:05	44.9	0.14	0.15	0.22	0.01
15:06	44.98	0.11	0.18	0.2	0
15:07	45.86	0.13	0.15	0.18	0
15:08	34.12	0.19	-0.05	0.24	0.01
15:09	29.94	0.21	-0.07	0.2	0.01
15:10	30.01	0.21	-0.06	0.2	0.01
15:11	34.52	0.12	-0.12	0.23	0.04
15:12	16	0.2	-0.11	0.07	0.02
15:13	14.9	0.23	-0.09	-0.34	0.01
15:14	14.9	0.22	0.01	-0.34	0
15:15	17.12	2.41	0.65	-0.34	0.37
15:16	2.14	0.26	0.16	-0.3	0.07
15:17	0	0.13	0.15	-0.2	0.05
15:18	0.1	0.12	0.15	-0.19	0.03
15:19	-0.03	0.06	0.16	-0.3	0.02
15:20	0.11	0.05	0.12	-0.3	0.02
15:21	0.68	5.23	0.11	-0.18	0.08
15:22	0.31	12.01	-0.07	-0.21	0.03
15:23	0.08	15.34	0.19	-0.36	0.09
15:24	-0.04	20.95	-0.04	-0.36	0.01
15:25	-0.13	20.98	-0.06	-0.3	0.02
15:26	-0.05	21	-0.07	-0.13	0.02
15:27	0.16	18.85	1.02	-0.38	0.31
15:28	0.58	0.58	3.05	-0.25	0.02
15:29	-0.13	0.12	3.25	-0.3	0
15:30	-0.21	0.07	3.26	-0.29	0.01
15:31	-0.16	0.05	3.26	-0.3	0.01
15:32	-0.26	0.03	3.27	-0.24	0
15:33	-0.23	0.02	3.2	-0.3	0
15:34	-0.14	0.06	2.98	-0.25	0.01
15:35	-0.16	0.11	2.95	-0.26	0.01
15:36	0.02	2.04	5.27	-0.3	0.12
15:37	-0.24	-0.04	9.56	-0.25	0.02
15:38	-0.45	0	9.59	-0.37	0.02
15:39	-0.42	-0.03	9.6	-0.31	0.01
15:40	0.2	8	6.14	-0.29	0.46
15:41	0.65	1.03	0.62	-0.3	7.59

15:42	0.22	0.1	0.2	-0.24	10.28
15:43	0.08	0.06	0.17	-0.28	15.19
15:44	-0.14	0.06	0.17	-0.33	8.28
15:45	0.07	0.03	0.17	-0.3	10
15:46	0.12	0.04	0.13	-0.24	9.94
15:47	0.15	1.26	0.18	-0.26	11.16
15:48	0.2	0.12	-0.07	-0.21	12.98
15:49	0.12	0.1	-0.03	-0.27	16.95
15:50	0.04	0.1	-0.04	-0.15	16.93
15:51	0.3	1.69	0.22	-0.22	13.82
15:52	0.3	0.1	-0.06	-0.27	4.96
15:53	0.07	0.11	0.03	-0.28	4.92
15:54	0.04	0.06	0.15	-0.42	4.9
15:55	0.13	2.21	0.52	-0.37	2.39
15:56	-0.05	0.05	0.13	-0.28	0.05
15:57	0.11	0.03	0.13	-0.32	0.03
15:58	0.09	0.02	0.18	-0.41	0.02
15:59	0.12	0.06	0.16	-0.39	0.02
16:00	10.87	3.45	0.59	-0.28	0.96
16:01	22.33	0.81	0.08	-0.24	0.17
16:02	3.21	1.17	0.16	-0.37	0.17
16:03	28.25	0.13	-0.09	-0.23	0.05
16:04	29.95	0.12	-0.1	-0.32	0.04
16:05	29.95	0.13	-0.08	-0.31	0.03
16:06	30.06	1.38	0.27	-0.28	0.09
16:07	8.27	15.22	3	2.27	0.95
16:08	1.37	15.31	2.98	-0.53	1.03
16:09	0.81	15.35	2.98	-0.52	1.09
16:10	0.85	15.35	2.98	-0.61	1.06
16:11	0.89	15.36	3	0.03	1.03
16:12	0.96	15.38	2.97	-0.04	1.02
16:13	1.03	15.46	2.79	0.07	0.99
16:14	1.02	15.47	2.77	-0.17	0.96
16:15	1.19	15.45	2.78	45.44	0.97
16:16	1.53	15.42	2.8	85.23	0.99
16:17	1.17	15.42	2.77	85.47	1.03
16:18	0.85	15.44	2.78	68.63	1.02
16:19	1.09	15.42	2.85	50.31	0.98
16:20	1.12	15.37	2.99	50.12	0.97
16:21	1.2	15.38	2.96	42.04	0.95
16:22	1.25	15.39	2.96	30.17	0.94
16:23	1.22	15.42	2.96	29.96	0.93
16:24	1.59	15.38	2.99	30	0.94
16:25	0.99	15.38	3	21.28	0.99
16:26	0.94	15.37	2.82	0.24	0.98
16:27	1.3	13.32	2.34	0.26	0.97
16:28	1.15	0.22	-0.04	0.11	1.02
16:29	0	0.15	-0.04	0.15	1.01
16:30	0.01	0.17	-0.08	0.15	1
16:31	0.06	0.14	-0.08	0.16	0.99
16:32	0.02	0.12	-0.04	0.26	0.98
16:33	0	0.07	0.14	0.28	0.97
16:34	-0.12	0.04	0.15	0.06	0.96
16:35	0.03	5.49	1.21	0.19	0.93
16:36	1.19	15.26	2.98	0.05	0.9
16:37	1.34	15.31	2.99	0.1	0.9
16:38	1.44	15.34	3.01	0.14	0.92
16:39	1.52	15.38	2.82	0.21	0.96

16:40	1.4	15.43	2.76	0.14	1
16:41	0.71	15.45	2.76	0.22	1.04
16:42	0.93	15.42	2.77	0.11	1.04
16:43	0.98	15.42	2.75	0.12	1.02
16:44	0.93	15.44	2.77	0.11	1
16:45	1.17	15.43	2.81	0.19	0.98
16:46	1.16	15.37	2.99	0.03	0.99
16:47	0.98	15.36	3.01	0.23	0.99
16:48	1.39	15.35	2.97	0.23	1
16:49	1.09	15.35	2.97	0.16	1.05
16:50	0.77	15.37	2.96	0.1	1.03
16:51	0.9	15.36	2.99	0.13	1.02
16:52	1.05	15.41	2.85	0.14	1.01
16:53	0.98	15.44	2.77	0.09	1.01
16:54	1.1	15.4	2.77	0.23	1.01
16:55	1.2	15.42	2.8	0.11	1
16:56	1.42	15.43	2.81	0.17	0.99
16:57	1.24	15.42	2.77	0.18	1.02
16:58	0.79	15.41	2.8	0.08	1.05
16:59	0.7	15.37	2.96	0.19	1
17:00	0.96	15.37	2.98	0.14	0.96
17:01	0.97	15.38	2.96	0.11	0.94
17:02	1.26	15.35	2.96	0.14	0.94
17:03	1.17	15.36	2.97	0.24	0.94
17:04	1.35	15.33	3	0.15	0.94
17:05	1.37	15.4	2.89	0.17	0.96
17:06	1.08	15.41	2.78	0.13	1.02
17:07	0.96	15.4	2.77	0.16	1
17:08	0.99	15.41	2.77	0.16	0.98
17:09	1.16	15.43	2.79	0.19	0.99
17:10	1.11	15.44	2.76	0.12	0.99
17:11	1.19	15.43	2.76	0.17	0.99
17:12	1.24	15.38	2.97	0.19	0.98
17:13	1.26	15.37	3.01	0.14	0.98
17:14	0.89	15.36	3.03	0.09	1.01
17:15	0.68	15.37	2.99	0.13	1.01
17:16	0.76	7.71	1.55	0.09	0.57
17:17	0	0.13	0.17	0.15	0.04
17:18	0.21	0.12	0.07	0.07	0.03
17:19	0	0.14	-0.07	0.23	0.04
17:20	0.07	0.13	-0.07	0.21	0.03
17:21	0.06	4	0.69	0.15	0.27
17:22	0.87	12.06	1.31	0.25	0.52
17:23	-0.03	12	-0.02	0.17	0.03
17:24	0.3	12.47	0.37	0.23	0.15
17:25	0.04	1.43	2.93	0.07	0.19
17:26	-0.13	0.06	3.17	0.18	0.02
17:27	-0.24	0.03	3.18	0.14	0.01
17:28	0.08	5.74	3.19	0.11	0.36
17:29	0.72	10.43	2.27	0.16	2.58
17:30	0.07	0.08	0.17	0.19	9.48
17:31	0.07	0.07	0.12	0.13	9.82
17:32	0.17	0.11	-0.03	0.17	9.91
17:33	0.29	3.7	0.64	0.13	7.85
17:34	15.44	1.42	0.16	0.18	1.69
17:35	29.89	0.12	-0.05	0.16	0.07
17:36	29.53	0.11	-0.06	0.14	0.05
17:37	29.88	0.11	-0.08	0.14	0.04

17:38	25.5	6.7	1.37	1.72	0.43
17:39	2.01	15.3	2.96	-0.06	0.97
17:40	1.05	15.31	3.01	-0.06	0.99
17:41	1.01	15.32	2.99	16.62	1.05
17:42	0.58	15.34	2.99	49.73	1.05
17:43	0.57	15.36	2.99	49.79	1.02
17:44	0.67	15.37	2.92	30.41	1.01
17:45	0.42	15.42	2.77	0.26	1
17:46	0.87	15.43	2.76	0.21	0.99
17:47	0.68	15.42	2.76	0.27	1.01
17:48	0.94	15.43	2.76	0.16	1.01
17:49	0.94	15.42	2.8	0.17	1
17:50	0.96	15.43	2.78	0.21	1.04
17:51	0.48	15.36	2.96	0.14	1.05
17:52	0.73	15.37	2.99	0.15	1.02
17:53	0.7	15.36	3.01	0.12	1
17:54	0.74	15.37	2.97	0.14	1
17:55	0.77	15.39	2.97	0.23	1
17:56	0.9	15.38	2.97	0.14	1.01
17:57	0.91	15.38	2.91	0.15	1.04
17:58	0.96	15.45	2.8	0.14	1.05
17:59	0.85	15.42	2.79	0.14	1.09
18:00	0.68	15.42	2.78	0.19	1.09
18:01	0.79	15.42	2.78	0.14	1.07
18:02	0.83	15.41	2.8	0.14	1.1
18:03	1.09	15.43	2.76	0.16	1.05
18:04	1	15.37	2.94	0.12	1.05
18:05	1.18	15.38	2.96	0.19	1.04
18:06	1.38	15.37	2.99	0.13	1.03
18:07	1.46	15.35	2.99	0.16	1.05
18:08	0.67	15.35	2.99	0.18	1.08
18:09	0.78	15.37	2.99	0.1	1.04
18:10	1.07	15.36	2.93	0.09	1.03
18:11	1.07	15.4	2.81	0.24	1.03
18:12	1.19	15.44	2.76	0.19	1.04
18:13	1.16	15.44	2.76	0.25	1.03
18:14	1.28	15.45	2.76	0.17	1.02
18:15	1.3	15.42	2.78	0.22	1.04
18:16	0.91	15.42	2.78	0.14	1.09
18:17	0.73	15.39	2.93	0.15	1.08
18:18	0.87	15.37	2.98	0.1	1.06
18:19	0.97	15.35	3.01	0.17	1.06
18:20	1.05	15.34	3	0.11	1.05
18:21	1.04	15.37	2.97	0.03	1.05
18:22	1.23	15.36	2.97	0.05	1.04
18:23	1.3	15.39	2.91	0.15	1.06
18:24	1.05	15.41	2.8	0.15	1.12
18:25	1.7	11.83	2.07	0.14	0.96
18:26	0.77	0.18	-0.05	0.13	0.05
18:27	-0.01	0.15	-0.05	0.06	0.03
18:28	0.17	0.12	-0.02	0.13	0.03
18:29	0.02	0.1	-0.03	0.05	0.03
18:30	0.03	0.06	0.09	0.18	0.01
18:31	0.33	3.43	0.31	0.12	0.09
18:32	0.13	11.9	0.14	0.09	0
18:33	0	11.94	0.16	0.04	0
18:34	0	11.95	0.15	0.21	0.01
18:35	0.14	9.14	1.72	0.19	0.38

18:36	-0.07	0.06	3.1	0.05	0.02
18:37	-0.03	0.06	2.98	0.08	0.01
18:38	0.22	6.77	2.85	0	0.44
18:39	0.66	1.08	0.3	0.05	8.34
18:40	0.23	0.11	-0.07	0.15	9.76
18:41	0.05	0.09	-0.06	0.25	9.93
18:42	0.32	5.36	0.95	0.18	6.29
18:43	23.16	0.09	0.09	0.18	0.1
18:44	29.72	0.05	0.15	0.12	0.04
18:45	29.81	0.02	0.16	0.16	0.03
18:46	29.79	0.04	0.19	0.01	0.02
18:47	19.73	10.4	2.09	14.72	0.67
18:48	1.29	15.29	2.97	26.17	1.06
18:49	0.77	15.32	2.9	-0.05	1.09
18:50	1	15.4	2.79	-0.01	1.06
18:51	1.16	15.39	2.77	0.01	1.06
18:52	1.07	15.39	2.78	25.43	1.06
18:53	1.27	15.43	2.78	50.05	1.05
18:54	1.37	15.41	2.8	50.15	1.04
18:55	1.5	15.42	2.8	24.6	1.04
18:56	1.43	15.38	2.93	0.2	1.08
18:57	0.95	15.35	2.96	0.28	1.07
18:58	1.11	15.35	2.96	0.24	1.04
18:59	1.12	15.34	2.99	0.1	1.03
19:00	1.32	15.37	2.98	0.12	1.02
19:01	1.09	15.37	2.99	0.13	1.02
19:02	1.57	15.36	2.94	0.08	1.02
19:03	1.52	15.42	2.82	0.12	1.04
19:04	0.96	15.42	2.8	0.1	1.09
19:05	1.28	15.41	2.76	0.17	1.1
19:06	1.18	15.45	2.76	-0.03	1.07
19:07	1.2	15.42	2.77	0.17	1.05
19:08	1.29	15.42	2.78	0.11	1.02
19:09	1.2	15.36	2.92	0.14	1.03
19:10	1.06	15.38	2.99	0.11	1.06
19:11	0.94	15.37	2.99	0.07	1.06
19:12	1.24	15.35	3.02	0.1	1.07
19:13	0.93	15.37	2.98	0.11	1.12
19:14	0.7	15.37	2.97	0.09	1.08
19:15	1.16	15.37	2.92	0.15	1.06
19:16	0.9	15.42	2.78	0.13	1.06
19:17	1.08	15.41	2.78	0.14	1.06
19:18	1.13	15.43	2.77	0.12	1.06
19:19	1.29	15.42	2.78	0.12	1.05
19:20	1.49	15.41	2.79	0.13	1.04
19:21	1.19	15.39	2.82	0.1	1.09
19:22	0.98	15.38	2.91	0.1	1.06
19:23	1.19	15.35	2.96	0.1	1.03
19:24	1.07	15.36	2.97	0.07	1.03
19:25	1.28	15.37	3	0.11	1.04
19:26	1.51	15.33	2.97	0.06	1.04
19:27	1.69	15.38	2.99	0.15	1.01
19:28	1.53	15.36	2.96	0.16	1.04
19:29	0.95	15.42	2.82	0.09	1.07
19:30	0.76	15.41	2.8	0.09	1.03
19:31	1.03	15.46	2.77	0.05	1.01
19:32	1.14	15.41	2.76	0.01	1.01
19:33	2.25	8.87	1.48	0.02	0.69

19:34	-0.08	0.17	-0.04	0	0.04
19:35	0.19	0.08	0.07	0.06	0.03
19:36	0.1	0.04	0.15	0.02	0.03
19:37	-0.04	0.19	0.2	0.03	0.02
19:38	0.03	11.61	0.63	-0.11	0.18
19:39	-0.09	11.95	0.16	0.11	0.01
19:40	0.11	10.06	1.72	0.05	0.44
19:41	0.01	0.06	3.1	0.11	0.02
19:42	-0.22	0.07	2.93	0.09	0.01
19:43	0.01	6.87	2.86	0.11	0.46
19:44	1.22	14.48	2.81	0.05	1.04
19:45	0.23	0.22	-0.01	0.07	9.25
19:46	0.13	0.1	-0.06	0.08	9.79
19:47	0.05	0.09	-0.02	0.06	9.9
19:48	3.2	2.63	0.67	0.07	5.1
19:49	27.6	0.06	0.14	0.03	0.07
19:50	29.58	0.06	0.14	0.08	0.04
19:51	29.06	0.02	0.14	0.06	0.03
19:52	29.86	0.04	0.15	0.05	0.02
19:53	25.19	7.23	1.51	2.19	0.5
19:54	2.51	15.3	2.96	-0.09	1.03
19:55	1.58	15.36	2.78	-0.1	1.03
19:56	1.31	15.38	2.82	-0.09	1.02
19:57	1.31	15.38	2.79	27.22	1.03
19:58	1.57	15.41	2.79	49.58	1.03
19:59	1.61	15.42	2.78	49.78	1.05
20:00	0.76	15.42	2.77	49.95	1.09
20:01	1.12	15.38	2.89	50.07	1.06
20:02	1.86	13.63	2.62	17.61	1.06
20:03	5.95	0.16	0.14	0.2	0.12
20:04	4.89	0.08	0.14	0.13	0.03
20:05	4.66	0.07	0.16	0.11	0.02
20:06	4.78	0.04	0.17	0.1	0.02
20:07	7.08	5.73	0.18	0.09	0.02
20:08	11.82	0.11	-0.04	0.11	0.02
20:09	9.79	0.1	-0.06	0.11	0.01
20:10	9.89	0.09	-0.03	0.15	0.01
20:11	9.53	1.41	-0.08	1.66	0.01
20:12	14.36	0.1	-0.08	1.29	0.01
20:13	15	0.11	-0.09	1.25	0.01
20:14	14.52	2.7	-0.01	1.16	0.01

Test Events Log Runs 7 - 12

Job No.	101494.1.004.02	Operator:	Daniel Neal
Client:	CCSI	Date:	19-Jul-00
Plant:	Gianera Generating Station		
Location:	Gas Turbine Outlet		

4:21	Send N_2 direct to all analyzers
4:25	Set Zero on the CO analyzer
4:25	Send High CO directly to all analyzers
4:28	Set High CO Calibration
4:28	Send Mid CO directly to all analyzers
4:31	Record Mid CO reading
4:31	Send Low CO directly to all analyzers
4:35	Record Low CO reading
4:35	Send N2 to the system
4:41	Set Zero on O_2, CO_2, and NO_X analyzers, record CO zero
4:41	Send Mid O_2 to system
4:46	Set Mid O_2 on O_2 analyzer
4:46	Send High O_2 to system
4:51	Record High O_2 reading on the O_2 analyzer
4:51	Send Mid CO_2 to system
5:44	Set Mid CO_2 on CO_2 analyzer
5:44	Send High CO_2 to system
5:47	Record High CO_2 reading on the CO_2 analyzer
5:47	Send Mid NO to the system
5:53	Set Mid NO on NO_X analyzer
5:53	Send High NO to system, change analyzer to Manual Mode
5:56	Record High NO reading on the NO_X analyzer
5:56	Send Low NO to the system
6:00	Record Low NO reading on the NO_X analyzer
6:00	Send Mid CO to system
6:05	Record Mid CO reading on the CO analyzer
6:08	Send Zero gas to THC system
6:13	Set Zero on the THC analyzer
6:13	Send High THC to THC system
6:19	Set High on the THC analyzer
6:19	Send Mid THC to THC system
6:22	Record Mid THC reading on the THC analyzer
6:22	Send Low THC to THC system
6:25	Record Low THC reading on the THC analyzer
	Turn to "Sample" and set probe at 1st sampling point
6:40	Start Run 7
7:12	End Run 7
7:12	Send N_2 thru the system to all analyzers
7:17	Record O2 zero
7:17	Record CO2 zero
7:17	Record Nox zero
7:17	Record CO zero
7:17	Send Mid O2 to system
7:20	Record Mid O2 reading on the O2 analyzer
7:20	Send Mid CO2 to system
7:23	Record Mid CO2 reading on the CO2 analyzer

7:23 Send Mid NOx to system
7:28 Record Mid NOx reading on the NOx analyzer
7:28 Send Mid CO to system
7:32 Record Mid CO reading on the CO analyzer
7:33 Send zero to THC system
7:36 Record zero THC reading on the THC analyzer
7:36 Send Mid THC to system
7:40 Record Mid THC reading on the THC analyzer

7:45 Start Run 8
8:17 End Run 8

8:17 Send N_2 thru the system to all analyzers
18:21 Record O2 zero
18:21 Record CO2 zero
18:21 Record Nox zero
18:21 Record CO zero
18:21 Send Mid O2 to system
18:25 Record Mid O2 reading on the O2 analyzer
18:25 Send Mid CO2 to system
18:28 Record Mid CO2 reading on the CO2 analyzer
18:28 Send Mid NOx to system
8:33 Record Mid NOx reading on the NOx analyzer
8:33 Send Mid CO to system
8:37 Record Mid CO reading on the CO analyzer
8:37 Send zero to THC system
8:40 Record zero THC reading on the THC analyzer
8:40 Send Mid THC to system
8:44 Record Mid THC reading on the THC analyzer

8:50 Start Run 9
9:22 End Run 9

9:27 Send N_2 thru the system to all analyzers
9:30 Record O2 zero
9:30 Record CO2 zero
9:30 Record Nox zero
9:31 Record CO zero
9:32 Send Mid O2 to system
9:36 Record Mid O2 reading on the O2 analyzer
9:36 Send Mid CO2 to system
9:39 Record Mid CO2 reading on the CO2 analyzer
9:39 Send Mid NOx to system
9:43 Record Mid NOx reading on the NOx analyzer
9:43 Send Mid CO to system
9:49 Record Mid CO reading on the CO analyzer
9:49 Send zero to THC system
9:54 Record zero THC reading on the THC analyzer
9:54 Send Mid THC to system
9:58 Record Mid THC reading on the THC analyzer

11:20 Start Run 10
11:52 End Run 10

11:53 Send N_2 thru the system to all analyzers
11:58 Record O2 zero
11:58 Record CO2 zero
11:58 Record Nox zero

11:58 Record CO zero
11:58 Send Mid O2 to system
12:01 Record Mid O2 reading on the O2 analyzer
12:01 Send Mid CO2 to system
12:04 Record Mid CO2 reading on the CO2 analyzer
12:04 Send Mid NOx to system
12:09 Record Mid NOx reading on the NOx analyzer
12:09 Send Mid CO to system
12:15 Record Mid CO reading on the CO analyzer
12:15 Send zero to THC system
12:19 Record zero THC reading on the THC analyzer
12:19 Send Mid THC to system
12:24 Record Mid THC reading on the THC analyzer

12:30 Start Run 11
13:02 End Run 11

13:05 Send N_2 thru the system to all analyzers
13:10 Record O2 zero
13:10 Record CO2 zero
13:10 Record Nox zero
13:10 Record CO zero
13:10 Send Mid O2 to system
13:13 Record Mid O2 reading on the O2 analyzer
13:13 Send Mid CO2 to system
13:16 Record Mid CO2 reading on the CO2 analyzer
13:16 Send Mid NOx to system
13:21 Record Mid NOx reading on the NOx analyzer
13:21 Send Mid CO to system
13:25 Record Mid CO reading on the CO analyzer
13:25 Send zero to THC system
13:28 Record zero THC reading on the THC analyzer
13:28 Send Mid THC to system
13:32 Record Mid THC reading on the THC analyzer

13:36 Start Run 12
14:08 End Run 12

14:08 Send N_2 thru the system to all analyzers
14:12 Record O2 zero
14:12 Record CO2 zero
14:12 Record Nox zero
14:12 Record CO zero
14:12 Send Mid O2 to system
14:16 Record Mid O2 reading on the O2 analyzer
14:16 Send Mid CO2 to system
14:19 Record Mid CO2 reading on the CO2 analyzer
14:19 Send Mid NOx to system
14:25 Record Mid NOx reading on the NOx analyzer
14:25 Send Mid CO to system
14:31 Record Mid CO reading on the CO analyzer
14:31 Send zero to THC system
14:34 Record zero THC reading on the THC analyzer
14:34 Send Mid THC to system
14:40 Record Mid THC reading on the THC analyzer

ETV/RTI Verification Test
2nd Day AM & PM Test
Time is 04:21:30.73.
Date is 7-19-2000.

Time	CO	O2	CO2	TGOC	NOx
	ppm	%	%	ppm	ppm
4:21	-0.24	20.14	0.29	1.12	0
4:22	-0.29	20.07	0.23	1.34	0
4:23	-0.15	0.71	0.03	1.23	0.01
4:24	-0.05	0.1	-0.09	1.22	0
4:25	-0.07	0.05	-0.11	1.37	0
4:26	1.55	-0.02	-0.1	1.38	0.03
4:27	39.52	0.02	-0.11	1.44	0.02
4:28	45.04	0.07	-0.12	1.35	0
4:29	44.61	0.01	-0.09	1.21	0.01
4:30	30.38	-0.04	0.13	1.03	-0.01
4:31	30.12	-0.05	0.17	1.05	-0.02
4:32	33.24	-0.16	0.15	1.08	0.01
4:33	18.81	-0.03	0.15	0.97	-0.01
4:34	14.97	-0.07	0.15	0.97	-0.01
4:35	14.98	-0.05	0.16	1.01	-0.02
4:36	12.44	13.68	0.05	1.13	0.01
4:37	1.36	0.25	-0.11	1.01	0.01
4:38	0.12	0.04	-0.1	1	0.01
4:39	0.26	0.02	-0.11	1.07	0.01
4:40	-0.07	0.03	-0.03	1.1	0
4:41	0.16	0.02	-0.05	1.11	0
4:42	0.59	5.51	-0.05	0.97	0.01
4:43	0.26	11.83	0.15	0.99	0
4:44	-0.04	11.87	0.17	0.95	0
4:45	-0.09	11.9	0.18	1.03	-0.01
4:46	0	11.95	0.15	1.06	-0.01
4:47	0.05	15.26	0.16	1.11	-0.01
4:48	-0.07	20.84	0.15	1.16	-0.01
4:49	-0.2	20.89	0.1	1.11	-0.01
4:50	-0.09	20.92	-0.06	1.14	0
4:51	-0.08	20.93	-0.05	1.18	0
4:52	-0.19	9.28	1.45	1.23	0.01
4:53	-0.19	0.12	2.9	1.25	0
4:54	-0.15	0.05	2.91	1.41	0.01
4:55	-0.17	0.04	2.91	1.4	0.01
4:56	-0.22	-0.04	3.13	1.46	0
4:57	-0.2	-0.03	3.14	1.4	0
4:58	-0.22	-0.08	3.14	1.34	0
4:59	-0.2	-0.06	3.06	1.37	0
5:00	-0.22	-0.07	3.06	1.09	0
5:01	-0.2	2.3	4.39	1.16	-0.01
5:02	-0.44	-0.14	9.57	1.15	0
5:03	-0.4	-0.12	9.45	1.07	0.01
5:04	-0.44	3.42	7.76	1.09	0.01
5:05	0.28	0.23	3	1.34	0
5:06	-0.07	-0.01	2.91	1.28	0
5:07	-0.17	0	2.9	1.17	0
5:08	-0.16	-0.02	2.91	1.35	0
5:09	-0.2	-0.06	3.1	1.21	-0.01
5:10	-0.2	-0.08	3.15	1.12	0
5:11	-0.27	-0.07	3.16	1.28	-0.01
5:12	-0.27	-0.1	3.22	1.13	-0.01
5:13	-0.26	-0.08	3.27	1.38	0
5:14	0.1	-0.08	3.26	1.21	-0.01
5:15	-0.17	-0.07	3.19	1	-0.01
5:16	-0.17	-0.04	3.02	0.94	0
5:17	-0.22	-0.03	2.98	1.22	0
5:18	-0.22	-0.03	2.96	1.12	0

5:19	-0.11	0.96	1.77	1.16	0
5:20	-0.01	0.02	-0.06	1.12	0
5:21	0.04	0	0	0.94	0
5:22	0	-0.04	0.16	0.99	-0.01
5:23	-0.03	-0.05	0.24	1.03	-0.02
5:24	-0.07	-0.07	0.25	1	-0.02
5:25	-0.03	-0.05	0.26	0.98	-0.02
5:26	-0.13	-0.06	0.27	0.9	-0.01
5:27	-0.02	-0.08	0.23	0.95	-0.01
5:28	-0.02	-0.05	0.17	0.95	-0.01
5:29	-0.02	0.01	-0.07	0.93	0
5:30	-0.11	0.01	-0.05	0.91	0
5:31	0.06	-0.01	-0.07	0.94	0
5:32	-0.02	0.01	-0.06	1.04	0
5:33	0.07	0.02	-0.04	1.09	-0.01
5:34	0.04	-0.01	0	1.1	-0.01
5:35	-0.05	-0.03	0.16	1.25	-0.01
5:36	-0.13	1.59	1.53	1.16	-0.01
5:37	-0.25	-0.09	3.31	1.04	-0.02
5:38	-0.41	-0.1	3.28	0.98	-0.01
5:39	-0.29	-0.09	3.26	0.89	-0.02
5:40	-0.27	-0.11	3.18	0.98	-0.01
5:41	-0.25	-0.1	3.12	0.9	-0.01
5:42	-0.21	-0.03	2.86	1	0
5:43	-0.28	-0.04	2.85	0.97	0.01
5:44	-0.12	-0.04	2.9	1	0
5:45	-0.18	7.6	3.18	0.96	0.01
5:46	-0.45	-0.1	9.17	0.91	0
5:47	-0.44	-0.12	9.21	0.93	0.01
5:48	-0.54	-0.14	9.31	0.81	0
5:49	-0.52	7.65	5.8	0.92	0.01
5:50	-0.18	2.43	0.4	0.92	5.57
5:51	-0.08	-0.03	0.27	0.87	9.89
5:52	-0.09	-0.03	0.23	0.8	10.01
5:53	-0.06	-0.04	0.25	0.94	9.95
5:54	0.01	0.96	0.34	0.93	10.89
5:55	0.11	0	0.08	0.86	16.84
5:56	-0.01	-0.01	0.01	0.95	16.8
5:57	-0.01	0.36	0.03	0.91	16.17
5:58	0.01	0.52	0.09	0.99	5.56
5:59	-0.04	-0.01	0	1.06	4.88
6:00	0.04	-0.02	0.01	1.08	4.87
6:01	-0.02	4.99	0.08	1	3.67
6:02	-0.03	-0.02	0.22	0.93	0.03
6:03	2.67	1.61	0.28	1.04	0.65
6:04	27.85	-0.03	0.23	1.05	0.05
6:05	29.83	-0.06	0.23	0.92	0.02
6:06	26.08	1.18	0.23	0.88	0.08
6:07	1.44	2.05	0.27	1	0.01
6:08	19.57	0.39	0.13	0.95	0.04
6:09	18.75	13.33	0.04	3.19	0.06
6:10	0.09	20.11	0.05	0	0.07
6:11	0.17	20.1	0.06	-0.04	0.06
6:12	0.25	20.12	0.06	-0.2	0.05
6:13	0.24	20.18	0.03	0.02	0.05
6:14	0.16	20.17	0.05	29.73	0.04
6:15	0.08	20.11	0.22	84.96	0.05
6:16	-0.05	20.12	0.24	85.25	0.05
6:17	-0.02	20.13	0.26	85.06	0.04
6:18	-0.09	20.12	0.27	85.24	0.04
6:19	-0.09	20.13	0.27	85.04	0.04
6:20	0	20.1	0.27	66.76	0.04
6:21	0.05	20.12	0.21	50.05	0.04
6:22	0.12	20.15	0.05	49.95	0.05

6:23	0.16	20.19	0.05	38.14	0.04
6:24	0.07	20.17	0.04	30	0.04
6:25	0.12	20.18	0.03	30	0.04
6:26	0.11	20.2	0.04	29.94	0.04
6:27	0.23	20.19	0.02	15.41	0.03
6:28	0.11	20.11	0.21	2.47	0.02
6:29	0.28	20.14	0.24	0.03	0.02
6:30	0.23	20.1	0.28	1.21	0.02
6:31	0.22	20.12	0.28	1.12	0.02
6:32	0.25	20.14	0.26	1.16	0.02
6:33	0.21	20.09	0.27	1.25	0.02
6:34	0.1	20.1	0.18	0.34	0.03
6:35	-0.16	20.2	0.06	0.16	0.03
6:36	0.23	20.24	0.03	0.23	0.03
6:37	0.94	15.68	2.59	0.23	1.03
6:38	1.29	15.41	2.69	0.19	1.08
6:39	0.95	15.39	2.69	0.19	1.2
6:40	0.79	15.4	2.71	0.21	1.19
6:41	0.9	15.33	2.88	0.16	1.15
6:42	0.73	15.34	2.97	0.17	1.14
6:43	1.04	15.33	2.97	0.15	1.13
6:44	1.11	15.3	3	0.21	1.12
6:45	1.03	15.32	2.97	0.21	1.12
6:46	1.17	15.31	2.97	0.11	1.12
6:47	1.16	15.33	2.91	0.18	1.17
6:48	0.75	15.38	2.71	0.13	1.19
6:49	1	15.38	2.75	0.24	1.15
6:50	0.99	15.39	2.72	0.19	1.14
6:51	1.05	15.37	2.73	0.17	1.13
6:52	0.98	15.36	2.71	0.16	1.13
6:53	1.02	15.39	2.77	0.14	1.11
6:54	0.98	15.32	2.88	0.16	1.1
6:55	1.09	15.31	2.96	0.18	1.09
6:56	1.11	15.31	2.96	0.09	1.12
6:57	0.52	15.3	2.96	0.15	1.14
6:58	0.73	15.31	2.99	0.08	1.11
6:59	0.89	15.35	2.96	0.15	1.1
7:00	0.97	15.34	2.96	0.17	1.09
7:01	0.91	15.39	2.72	0.1	1.1
7:02	0.68	15.4	2.73	0.14	1.1
7:03	1.54	15.36	2.75	0.18	1.11
7:04	2.15	15.4	2.75	0.16	1.1
7:05	0.62	15.4	2.73	0.14	1.14
7:06	0.81	15.38	2.71	0.11	1.19
7:07	1.04	15.36	2.85	0.12	1.15
7:08	1.11	15.33	2.99	0.21	1.12
7:09	1.24	15.35	2.96	0.07	1.12
7:10	1.3	15.34	2.95	0.01	1.11
7:11	0.81	15.32	2.95	0.18	1.1
7:12	0.97	15.32	2.98	0.17	1.1
7:13	1.49	14.45	2.75	0.17	1.06
7:14	1.17	0.28	0.08	0.13	0.04
7:15	-0.02	0.12	0.04	0.04	0.03
7:16	0.04	0.09	0.04	0.12	0.03
7:17	0.01	0.07	0.07	0.2	0.02
7:18	0	4.09	0.3	-0.02	0.12
7:19	-0.15	11.98	0.04	-0.05	0.01
7:20	-0.21	11.98	0.07	0.06	0.01
7:21	0.11	8.7	1.67	0.14	0.32
7:22	-0.31	-0.02	3.07	0.12	0.01
7:23	-0.81	-0.01	3.06	0.2	0
7:24	-0.02	6.77	3.06	0.04	0.5
7:25	0.46	3.81	0.98	0.05	6.65
7:26	-0.06	-0.01	0.25	0.07	9.55

7:27	-0.01	0.04	0.11	0.1	9.7
7:28	0.03	0.05	0.03	0.15	9.74
7:29	1.6	3.28	0.66	0.1	5.79
7:30	26.88	0.05	0.01	0.12	0.09
7:31	29.54	0.05	0.04	0.03	0.05
7:32	29.85	0.08	0.02	0.14	0.03
7:33	29.76	0.04	0	0.08	0.03
7:34	22.55	8.27	1.76	0.39	0.61
7:35	1.38	15.24	2.92	-0.04	1.1
7:36	0.92	15.28	2.95	-0.07	1.1
7:37	0.98	15.32	2.95	0.48	1.1
7:38	1.19	15.31	2.96	48.35	1.11
7:39	1.2	15.3	2.95	49.58	1.12
7:40	0.83	15.38	2.89	49.63	1.17
7:41	0.74	15.38	2.73	16.4	1.14
7:42	0.89	15.41	2.73	0.12	1.1
7:43	1	15.42	2.73	0.18	1.09
7:44	1.06	15.41	2.75	0.25	1.08
7:45	1	15.41	2.77	0.14	1.09
7:46	1.1	15.38	2.73	0.16	1.08
7:47	1.26	15.35	2.9	0.07	1.06
7:48	1.15	15.36	2.97	0.07	1.08
7:49	0.87	15.33	2.96	0.1	1.13
7:50	0.81	15.33	2.96	0.11	1.1
7:51	0.86	15.35	2.95	0.11	1.08
7:52	0.89	15.35	2.95	0.09	1.08
7:53	1.01	15.36	2.93	0.11	1.08
7:54	1.05	15.41	2.72	0.12	1.09
7:55	1.07	15.4	2.75	0.1	1.09
7:56	1.22	15.4	2.74	0.15	1.09
7:57	1.27	15.4	2.74	0.13	1.1
7:58	0.59	15.39	2.73	0.1	1.13
7:59	0.86	15.42	2.72	0.13	1.09
8:00	0.94	15.39	2.87	0.04	1.05
8:01	0.9	15.34	2.97	0.12	1.05
8:02	0.94	15.35	2.97	0.09	1.04
8:03	1.03	15.36	2.97	0.09	1.03
8:04	1.09	15.34	2.97	0.12	1.03
8:05	1.15	15.34	2.99	0.08	1.04
8:06	0.68	15.35	2.95	0.07	1.09
8:07	0.75	15.4	2.74	0.13	1.08
8:08	0.89	15.42	2.73	0.11	1.07
8:09	0.96	15.43	2.71	0.09	1.06
8:10	0.95	15.43	2.74	0.1	1.07
8:11	0.98	15.43	2.7	0.13	1.07
8:12	1.05	15.42	2.69	0.13	1.07
8:13	1.3	15.41	2.75	0.12	1.07
8:14	1.16	15.35	2.95	0.11	1.07
8:15	0.57	15.36	3	0.1	1.11
8:16	0.73	15.37	2.98	0.13	1.07
8:17	0.75	15.38	2.98	-0.02	1.05
8:18	1.51	10.4	2.06	0.19	0.76
8:19	0.66	0.1	0.24	0.05	0.03
8:20	-0.08	0.09	0.18	0.17	0.02
8:21	0.02	0.12	0.04	0.14	0.03
8:22	-0.05	0.08	0.01	0.16	0.03
8:23	-0.05	10.89	0.24	0.12	0.12
8:24	-0.06	12	0.01	0.2	0.01
8:25	-0.02	12.01	0.02	0.07	0.01
8:26	0.05	8.27	1.4	0.1	0.31
8:27	-0.29	0.07	3	0.12	0.01
8:28	-0.24	0.02	3.05	0.05	0
8:29	0.07	8.58	3.05	0.14	0.57
8:30	0.2	1.13	0.56	0.18	8.5

8:31	0	0.03	0.22	0.1	9.49
8:32	-0.07	0.02	0.23	0.2	9.58
8:33	-0.08	0	0.21	0.21	9.58
8:34	3.08	2.84	0.49	0.16	5.43
8:35	27.81	0.11	0.04	0.09	0.08
8:36	29.54	0.07	0.03	0.12	0.05
8:37	29.67	0.1	0	0.16	0.04
8:38	23.75	7.54	1.38	2.45	0.62
8:39	2.23	15.34	2.69	-0.01	1.03
8:40	1.06	15.34	2.82	0.01	1.07
8:41	0.55	15.33	2.98	25.75	1.1
8:42	0.79	15.35	2.96	49.18	1.07
8:43	0.88	15.35	2.98	49.22	1.06
8:44	0.84	15.36	2.97	49.31	1.05
8:45	0.93	15.36	2.97	49.27	1.05
8:46	1.19	15.37	2.98	21.11	1.03
8:47	1.14	15.42	2.79	0.22	1.02
8:48	1.09	15.43	2.69	0.29	1.05
8:49	0.63	15.44	2.7	0.16	1.08
8:50	0.84	15.45	2.69	0.21	1.05
8:51	0.97	15.44	2.69	0.19	1.03
8:52	0.91	15.46	2.69	0.13	1.03
8:53	0.99	15.45	2.69	0.19	1.03
8:54	0.89	15.4	2.93	0.13	1.01
8:55	1.27	15.39	2.94	0.18	1.01
8:56	1.29	15.37	2.96	0.35	1.01
8:57	1.05	15.38	2.96	0.39	1.06
8:58	0.68	15.38	2.96	0.39	1.05
8:59	1.01	15.39	2.96	0.39	1.02
9:00	1.18	15.38	2.92	0.39	1.02
9:01	0.98	15.44	2.75	0.41	1.02
9:02	1.18	15.43	2.76	0.4	0.99
9:03	1.24	15.44	2.73	0.4	0.99
9:04	1.33	15.44	2.71	0.42	0.99
9:05	1.19	15.45	2.73	0.39	1.02
9:06	0.62	15.46	2.71	0.4	1.03
9:07	0.99	15.43	2.86	0.37	1
9:08	1	15.39	2.96	0.39	0.98
9:09	1.02	15.39	2.96	0.38	0.98
9:10	1.02	15.4	2.98	0.39	0.98
9:11	1.23	15.37	2.97	0.38	0.98
9:12	1.21	15.35	2.99	0.39	1
9:13	1.01	15.37	2.97	0.38	1.04
9:14	1.11	15.44	2.79	0.4	1.05
9:15	1.21	15.44	2.73	0.41	1.03
9:16	1.05	15.46	2.73	0.43	1.03
9:17	1.23	15.43	2.71	0.43	1.04
9:18	1.14	15.45	2.73	0.43	1.03
9:19	0.95	15.45	2.7	0.44	1.02
9:20	1.66	15.44	2.71	0.44	1.02
9:21	1.2	15.37	2.92	0.43	1.04
9:22	0.82	15.39	2.93	0.43	1.05
9:23	0.87	15.38	2.97	0.43	1.02
9:24	0.96	15.38	2.94	0.44	1
9:25	1.06	15.39	2.95	0.44	0.99
9:26	1.4	15.39	2.94	0.44	0.98
9:27	1.37	14.94	2.74	0.46	0.97
9:28	0.61	0.35	0.06	0.46	0.06
9:29	0.02	0.17	0.01	0.47	0.04
9:30	-0.04	0.14	0.01	0.47	0.03
9:31	-0.02	0.13	0.01	0.48	0.03
9:32	-0.03	0.1	0	0.48	0.03
9:33	0.34	4.63	0.61	0.48	0.36
9:34	0.01	10	0.51	0.47	0.16

9:35	0	11.96	0.24	0.45	0.01
9:36	-0.25	11.96	0.24	0.46	0
9:37	0	10.3	1.52	0.46	0.26
9:38	-0.28	0.08	3.09	0.45	0.01
9:39	-0.35	0.03	3.07	0.46	0
9:40	0.08	7.68	3.03	0.47	0.5
9:41	0.35	0.74	0.18	0.48	8.39
9:42	0.02	0.12	0.01	0.48	9.46
9:43	0.01	0.09	0	0.48	9.55
9:44	0.23	5.54	1	0.48	6.42
9:45	21.05	0.16	-0.01	0.5	0.16
9:46	29.42	0.12	-0.03	0.49	0.06
9:47	29.57	0.08	0.04	0.48	0.04
9:48	29.38	0.02	0.25	0.47	0.02
9:49	29.48	0.04	0.26	0.44	0.02
9:50	23.21	7.9	1.65	23.52	0.51
9:51	1.83	15.26	2.92	33.54	0.98
9:52	1.07	15.31	2.96	0.4	1.05
9:53	0.68	15.34	3	0.32	1.08
9:54	1.12	15.38	2.8	0.33	1.06
9:55	1.08	15.41	2.69	0.34	1.06
9:56	0.98	15.44	2.68	45.02	1.05
9:57	1.2	15.46	2.7	49.06	1.05
9:58	1.38	15.46	2.71	49.07	1.05
9:59	1.48	15.45	2.66	25.35	1.05
10:00	1.41	15.44	2.67	0.63	1.07
10:01	0.75	15.39	2.93	0.53	1.08
10:02	1.04	15.39	2.94	0.5	1.04
10:03	1.1	15.38	3	0.48	1.03
10:04	1.21	15.38	2.96	0.48	1.03
10:05	1.35	15.37	2.95	0.49	1.03
10:06	1.28	15.38	2.97	0.49	1.03
10:07	1.44	15.42	2.89	0.48	1.03
10:08	1.27	15.42	2.73	0.5	1.09
10:09	0.87	15.47	2.71	0.49	1.08
10:10	1.18	15.43	2.69	0.52	1.06
10:11	1.24	15.46	2.68	0.5	1.04
10:12	1.24	15.47	2.7	0.49	1.04
10:13	1.48	15.45	2.68	0.5	1.01
10:14	2.19	15.41	2.84	0.49	0.98
10:15	1.93	15.38	2.92	0.49	0.99
10:16	0.93	15.4	2.92	0.49	1.02
10:17	1.09	15.39	2.99	0.45	0.99
10:18	1.42	15.36	2.97	0.48	0.97
10:19	1.31	15.38	2.95	0.49	0.97
10:20	1.42	15.37	2.92	0.49	0.96
10:21	1.53	15.44	2.72	0.5	0.97
10:22	1.73	15.45	2.76	0.49	0.97
10:23	1.45	15.44	2.69	0.49	1.02
10:24	1.05	15.43	2.68	0.51	1.02
10:25	1.35	15.46	2.69	0.5	0.99
10:26	1.57	15.46	2.67	0.5	0.99
10:27	1.51	15.43	2.83	0.49	0.99
10:28	1.72	15.38	2.92	0.49	0.98
10:29	1.73	15.37	2.91	0.48	0.98
10:30	1.78	15.41	2.95	0.46	1.01
10:31	1.05	15.39	2.98	0.47	1.04
10:32	1.24	15.36	2.99	0.49	1.01
10:33	1.43	15.38	2.96	0.48	1
10:34	1.68	15.43	2.74	0.5	1.01
10:35	1.92	15.44	2.7	0.51	1
10:36	1.99	15.43	2.72	0.51	1
10:37	2.28	15.44	2.7	0.5	1
10:38	1.25	15.44	2.67	0.5	1.07

10:39	1.37	15.45	2.67	0.51	1.04
10:40	1.7	15.44	2.72	0.5	1.01
10:41	1.63	15.38	2.93	0.53	0.99
10:42	1.94	15.38	2.93	0.53	0.99
10:43	1.93	15.37	2.93	0.51	0.99
10:44	2.21	15.37	2.94	0.5	0.99
10:45	1.36	15.36	2.97	0.49	1.05
10:46	1	15.36	2.99	0.49	1.04
10:47	1.46	15.42	2.77	0.51	1.04
10:48	1.59	15.47	2.71	0.5	1.03
10:49	1.86	15.45	2.69	0.52	1.04
10:50	1.9	15.43	2.68	0.51	1.04
10:51	2.07	15.45	2.68	0.51	1.05
10:52	1.62	15.47	2.67	0.51	1.1
10:53	1.13	15.47	2.69	0.5	1.1
10:54	1.44	15.38	2.92	0.49	1.06
10:55	1.57	15.37	2.95	0.49	1.04
10:56	1.59	15.39	2.95	0.48	1.04
10:57	1.8	15.38	2.94	0.48	1.04
10:58	2.07	15.37	2.96	0.51	1.05
10:59	1.66	15.38	2.97	0.52	1.09
11:00	0.98	15.42	2.85	0.5	1.1
11:01	1.41	15.44	2.68	0.52	1.07
11:02	1.46	15.46	2.68	0.51	1.05
11:03	1.53	15.47	2.67	0.51	1.04
11:04	1.6	15.45	2.67	0.51	1.05
11:05	1.92	15.44	2.68	0.5	1.02
11:06	2.13	15.46	2.68	0.52	1.03
11:07	1.23	15.4	2.9	0.49	1.06
11:08	1.34	15.38	2.95	0.48	1.03
11:09	1.55	15.38	2.97	0.48	1
11:10	1.66	15.36	2.96	0.49	1
11:11	1.94	15.37	2.96	0.48	0.99
11:12	2.03	15.4	2.95	0.49	1
11:13	2.28	15.41	2.85	0.49	1.02
11:14	1.45	15.42	2.72	0.52	1.06
11:15	1.36	15.44	2.67	0.51	1.05
11:16	1.84	15.48	2.67	0.5	1.02
11:17	1.93	15.44	2.66	0.51	1.01
11:18	1.99	15.45	2.68	0.51	1
11:19	2.09	15.45	2.71	0.51	1
11:20	2.51	15.39	2.86	0.49	1
11:21	1.76	15.38	2.94	0.49	1.05
11:22	1.42	15.4	2.95	0.48	1.02
11:23	1.73	15.38	2.98	0.49	1
11:24	1.85	15.39	2.96	0.48	0.99
11:25	2.01	15.38	2.91	0.49	0.99
11:26	2.14	15.42	2.87	0.48	0.99
11:27	2.39	15.44	2.68	0.52	1.02
11:28	1.4	15.46	2.7	0.49	1.07
11:29	1.46	15.45	2.66	0.53	1.06
11:30	1.74	15.43	2.68	0.46	1.03
11:31	1.92	15.45	2.69	0.28	1.03
11:32	1.92	15.46	2.71	0.3	1
11:33	2.12	15.39	2.84	0.24	1
11:34	2.21	15.39	2.93	0.25	1
11:35	1.61	15.38	2.93	0.24	1.04
11:36	1.22	15.39	2.94	0.26	1.03
11:37	1.56	15.42	2.95	0.25	1.01
11:38	1.72	15.4	2.9	0.26	0.99
11:39	1.92	15.38	2.91	0.26	0.98
11:40	2.21	15.46	2.68	0.28	0.99
11:41	2.2	15.45	2.68	0.24	1.01
11:42	1.27	15.44	2.72	0.23	1.08

11:43	1.22	15.48	2.7	0.28	1.06
11:44	1.51	15.44	2.68	0.24	1.05
11:45	1.69	15.46	2.7	0.23	1.04
11:46	1.62	15.41	2.8	0.25	1.05
11:47	1.62	15.39	2.94	0.19	1.05
11:48	2	15.4	2.92	0.25	1.04
11:49	1.73	15.37	2.92	0.26	1.07
11:50	0.92	15.41	2.92	0.08	1.09
11:51	1.35	15.37	2.96	0.24	1.04
11:52	1.37	15.39	2.91	0.21	1.04
11:53	1.78	15.45	2.73	0.24	1.02
11:54	2.44	10.61	1.8	0.09	0.74
11:55	0.61	0.21	0.05	0.17	0.03
11:56	-0.04	0.14	0.06	0.23	0.03
11:57	0.05	0.12	0.02	0.25	0.03
11:58	-0.03	0.12	0.01	0.26	0.02
11:59	0.14	5.61	0.48	0.3	0.19
12:00	-0.15	11.91	0.24	0.11	0.01
12:01	-0.07	11.97	0.23	0.21	0
12:02	0.16	10.87	1.05	0.15	0.29
12:03	0.05	0.09	3.03	0.14	0.02
12:04	-0.27	0.03	3.06	0.31	0.01
12:05	0.25	7.57	3.09	0.2	0.49
12:06	0.83	3.19	0.75	0.18	7.13
12:07	0.09	0.13	0.03	0.24	9.66
12:08	-0.05	0.11	0.02	0.25	9.77
12:09	0.04	0.1	0.05	0.2	9.78
12:10	1.68	2.98	0.52	0.31	6.24
12:11	26.96	0.13	0	0.23	0.1
12:12	29.72	0.09	0	0.26	0.06
12:13	29.56	0.06	0.21	0.19	0.04
12:14	29.73	0.04	0.24	0.3	0.02
12:15	29.68	0.04	0.23	0.33	0.02
12:16	21.61	8.66	1.82	2.65	0.58
12:17	1.46	15.28	2.9	0.07	1.02
12:18	1.55	15.31	2.94	0.05	1.02
12:19	1.9	15.37	2.86	0.07	1.01
12:20	1.96	15.43	2.69	27.75	1.01
12:21	1.95	15.4	2.68	48.86	1
12:22	2.34	15.44	2.67	48.95	0.99
12:23	2.59	15.44	2.68	49.06	1.01
12:24	1.43	15.45	2.68	48.91	1.05
12:25	1.76	15.47	2.67	49	1.01
12:26	1.81	15.39	2.87	18.8	0.99
12:27	2	15.38	2.91	0.37	0.98
12:28	2.14	15.39	2.97	0.34	0.97
12:29	2.27	15.4	2.94	0.26	0.97
12:30	2.42	15.36	2.94	0.23	0.99
12:31	1.22	15.39	2.94	0.25	1.05
12:32	1.4	15.41	2.85	0.23	1.03
12:33	1.82	15.43	2.69	0.29	1.01
12:34	1.88	15.46	2.67	0.25	1
12:35	2.03	15.46	2.67	0.24	0.99
12:36	2.08	15.44	2.66	0.24	1
12:37	2.19	15.46	2.69	0.25	1.03
12:38	1.24	15.45	2.7	0.24	1.06
12:39	1.42	15.4	2.86	0.26	1.03
12:40	1.73	15.41	2.94	0.2	1.01
12:41	1.62	15.41	2.96	0.21	1
12:42	1.84	15.37	2.98	0.22	0.99
12:43	2.07	15.39	2.92	0.23	0.99
12:44	2.15	15.38	2.92	0.2	1
12:45	1.34	15.43	2.84	0.22	1.06
12:46	1.38	15.46	2.7	0.23	1.04

12:47	1.53	15.46	2.67	0.21	1.02
12:48	1.52	15.48	2.68	0.27	1.02
12:49	1.55	15.46	2.68	0.22	1.02
12:50	1.68	15.47	2.69	0.29	1
12:51	1.82	15.45	2.72	0.26	1.01
12:52	1.57	15.38	2.84	0.25	1.04
12:53	0.95	15.39	2.92	0.22	1.07
12:54	1.25	15.38	2.91	0.26	1.02
12:55	1.5	15.4	2.91	0.24	1
12:56	1.72	15.38	2.91	0.19	1
12:57	1.96	15.37	2.9	0.2	1
12:58	2.3	15.4	2.88	0.21	1
12:59	2.31	15.47	2.68	0.21	1.03
13:00	1.33	15.44	2.72	0.3	1.06
13:01	1.76	15.47	2.7	0.1	1.02
13:02	1.97	15.46	2.69	0.28	1
13:03	2.64	11.55	1.95	0.23	0.79
13:04	1.11	0.19	0.05	0.19	0.04
13:05	-0.02	0.13	0.16	0.21	0.03
13:06	0	1.05	0.38	0.24	0.09
13:07	0.37	7.42	0.83	0.2	0.24
13:08	0.03	0.06	0.22	0.23	0.01
13:09	-0.04	0.07	0.25	0.2	0
13:10	-0.03	0.05	0.25	0.18	0
13:11	0.26	6.65	0.65	0.25	0.15
13:12	0.07	11.99	0.05	0.25	0.01
13:13	-0.02	12	0.04	0.19	0.01
13:14	0.22	9.38	1.44	0.2	0.35
13:15	-0.05	0.13	2.82	0.23	0.02
13:16	-0.2	0.11	2.82	0.21	0.02
13:17	0.26	6.43	2.82	0.27	0.42
13:18	0.79	2.81	0.7	0.2	7.69
13:19	0	0.06	0.22	0.2	9.72
13:20	0.02	0.05	0.23	0.17	9.78
13:21	0.04	0.02	0.24	0.21	9.78
13:22	0.83	2.94	0.78	0.17	6.85
13:23	25.68	0.07	0.28	0.21	0.1
13:24	29.65	0.04	0.24	0.2	0.05
13:25	29.67	0.12	0.06	0.19	0.04
13:26	24.25	7.27	1.34	2.73	0.51
13:27	2.34	15.37	2.67	0.05	1.02
13:28	1.04	15.39	2.68	0.05	1.06
13:29	1.25	15.43	2.66	29.34	1.04
13:30	1.48	15.44	2.67	48.51	1.04
13:31	1.57	15.4	2.73	48.6	1.03
13:32	1.6	15.39	2.94	48.58	1.01
13:33	1.46	15.37	2.92	48.61	1.02
13:34	1.79	15.38	2.92	41.66	1.02
13:35	1.03	15.4	2.95	0.45	1.06
13:36	1.18	15.35	2.93	0.32	1.03
13:37	1.46	15.42	2.94	0.23	1.01
13:38	1.42	15.41	2.71	0.29	1.03
13:39	1.73	15.48	2.67	0.27	1
13:40	1.62	15.46	2.66	0.27	1.01
13:41	1.88	15.45	2.7	0.23	1.02
13:42	1.31	15.47	2.69	0.23	1.08
13:43	0.89	15.44	2.68	0.25	1.09
13:44	1.05	15.45	2.73	0.22	1.07
13:45	0.99	15.39	2.92	0.2	1.05
13:46	0.95	15.37	2.94	0.22	1.04
13:47	1.06	15.4	2.91	0.21	1.04
13:48	1.2	15.4	2.9	0.21	1.03
13:49	1.18	15.39	2.9	0.19	1.04
13:50	1.2	15.41	2.92	0.17	1.05

13:51	0.75	15.43	2.78	0.19	1.08
13:52	0.8	15.46	2.68	0.24	1.05
13:53	1.01	15.46	2.69	0.22	1.03
13:54	1.01	15.47	2.69	0.18	1.02
13:55	1.26	15.47	2.72	0.2	0.99
13:56	1.43	15.47	2.68	0.23	0.98
13:57	1.9	15.45	2.7	0.22	0.97
13:58	1.32	15.41	2.89	0.21	1.02
13:59	0.94	15.39	2.92	0.2	1.04
14:00	1.29	15.4	2.91	0.22	0.99
14:01	1.4	15.41	2.89	0.2	0.98
14:02	1.4	15.4	2.91	0.21	0.98
14:03	1.51	15.4	2.91	0.21	0.98
14:04	1.67	15.44	2.85	0.27	0.97
14:05	1.93	15.45	2.69	0.23	0.99
14:06	1.27	15.48	2.69	0.23	1.02
14:07	0.92	15.47	2.69	0.22	1.02
14:08	1.34	15.45	2.69	0.23	0.99
14:09	1.31	15.47	2.68	0.24	0.99
14:10	1.71	1.28	0.16	0.24	0.16
14:11	-0.01	0.14	0.21	0.21	0.02
14:12	-0.06	0.11	0.21	0.2	0.02
14:13	-0.07	0.06	0.26	0.24	0.01
14:14	0.06	3.67	0.47	0.12	0.08
14:15	0.01	11.9	0.25	0.09	0.01
14:16	-0.06	11.93	0.25	0.24	0.01
14:17	-0.17	12.3	0.46	0.19	0.1
14:18	0.02	2.03	2.6	0.24	0.22
14:19	-0.14	0.12	2.83	0.2	0.01
14:20	0.14	6.57	2.75	0.22	0.55
14:21	0.26	0.27	0.04	0.21	9.36
14:22	Data acquisition system inadvertently shut down, then restarted. 14:22 data lost.				
14:23	0	0.37	-0.1	0.15	9.77
14:24	0.06	0.12	0.01	0.2	9.77
14:25	0.06	0.1	0.02	0.24	9.77
14:26	2.45	2.37	0.67	0.2	5.4
14:27	27.6	0.07	0.22	0.19	0.07
14:28	29.64	0.03	0.23	0.19	0.03
14:29	29.72	0.06	0.22	0.2	0.02
14:30	29.69	0.06	0.25	0.19	0.02
14:31	29.73	0.06	0.24	0.19	0.01
14:32	19.44	9.73	2	2.25	0.69
14:33	0.91	15.36	2.69	0.06	1.04
14:34	0.85	15.4	2.7	0.02	1.05
14:35	0.96	15.4	2.71	5.8	1.04
14:36	1.13	15.44	2.67	47.91	1.03
14:37	1.28	15.44	2.67	48.2	1.01
14:38	1.34	15.42	2.66	48.38	1
14:39	1.4	15.43	2.77	48.63	1.02
14:40	0.85	15.38	2.87	48.78	1.05
14:41	0.89	15.38	2.89	48.79	1.02
14:42	0.98	15.4	2.9	23.05	1
14:43	0.94	15.37	2.9	0.37	0.99
14:44	1.1	15.38	2.94	0.31	0.98

B.2 Raw Data – Ambient Conditions

Ambient Conditions Data Summary

Date: July 18, 2000

	Time	Temp. deg F	Pressure, in. Hg	Relative humidity, %
Run 1	7:05	14.8°C 59.70F 58.6°F	30.09	80.6
	7:20	14.8 59.6F 58.6°F	30.10	79.9
	7:30	15.1 59.9 59.2°F	30.10	79.1
Run 1 Avg.	7:00-7:32	58.8°F	30.10 in Hg	79.9%
Run 2	8:15	15.4C 60.3F 59.7	30.11	74.5
	8:25	15.9 60.4 60.4	30.12	76.4
	~~8:10-8:42~~ 8:35 CC	16.4 61.2 61.5	30.12	75.0
Run 2 Avg.	8:10-8:42	60.5°F	30.12 in Hg	75.3%
Run 3	9:27	16.4 61.6 61.5	30.12	73.4
	9:37	17.3 63.5 63.1	30.12	69.1
	9:47	17.8 64.0 64.0	30.10	68.0
Run 3 Avg.	9:20-9:52	62.9°F	30.11 in Hg	70.2%

↑

used thermocouple on thermohygrometer which reads in °C. The °C was converted to °F by x 9/5 + 32. The °F values are from another thermocouple for checking purposes. in upper right corner

Craig

Ambient Conditions Data Summary

Craig Chrisadalla

Date: July 18, 2000

	Time	Temp. deg F	Pressure, in. Hg	Relative humidity, %
Run #4	16:45	25.3°C 78.1°F 77.5	30.03	51.4
	16:55	25.2°C 77.9°F 77.4	30.02	50.4
	17:05	24.8 77.0 76.6	30.02	51.9
Run #4 Avg.	16:40-17:12	77.2°F	30.02 in Hg	51.2 %
Run #5	17:58	24.3 75.7 75.7	30.01	49.8
	18:14	23.7 74.7 74.7	30.01	52.5
	18:21	22.8 73.0 73.9	30.01	53.6
Run #5 Avg.	17:50-18:22	74.5°F	30.01 in Hg	52.0 %
Run #6	18:05	21.1 70.0 69.9	30.01	56.6
	19:20	21.4 70.9 70.8	30.01	58.6
	19:29	20.8 69.4 69.7	30.01	58.1
Run #6 Avg.	18:58-19:30	70.1°F	30.01 in Hg	57.8 %

used Taylor barometer # MRI Y-2101

Ambient Conditions Data Summary

Date: 7/19/00 Craig Clapsaddle

	Time	Temp. deg F	Pressure, in. Hg	Relative humidity, %
Run #7	6:44	13.9°C 57.0 °F	30.02	87.5
	6:53	14.6°C 58.3 °F	30.02	86.6
	7:07	14.7°C 58.5 °F	30.02	85.1
Run #7 Avg.	6:40 - 7:12	57.9 °F	30.02 in Hg	86.4 %
Run #8	7:52	16.0 60.8 °F	30.03	80.0
	8:07	16.0 60.8 °F	30.03	79.0
	8:15	16.0 60.8 °F	30.03	78.5
Run #8 Avg.	7:45 - 8:17	60.8 °F	30.03 in Hg	79.2 %
Run #9	8:57	16.4 61.5 °F	30.03	75.5
	9:09	17.0 62.6 °F	30.03	73.2
	9:20	17.5 63.5 °F	30.03	70.6
Run #9 Avg.	8:50 - 9:22	62.5	30.03 in Hg	73.1

Ambient Conditions Data Summary

Date: July 19, 2000 Craig Oppenaddle

	Time	Temp. deg F	Pressure, in. Hg	Relative humidity, %
Run 10	11:28	20.8 69.4 69.4	30.02	60.7
	11:36	20.7 68.9 69.3	30.02	628
	11:44	21.0 69.6 69.8	30.02	60.6
Run 10 Avg.	11:20-11:52	69.5 °F	30.02 in Hg	61.4 %
Run 11	12:38	21.6 70.9 20.8	30.01	61.8
	12:46	21.4 70.5 20.6	30.01	62.1
	12:55	22.4 72.3 21.9	30.01	60.8
Run 11 Avg.	12:30-13:02	71.2 °F	30.01 in Hg	61.6 %
Run 12	13:44	23.3 73.9 23.6	30.00	54.5
	13:53	23.4 74.1 74.3	30.00	52.9
	14:04	23.9 75.0 75.1	30.00	51.6
Run 12 Avg.	13:36-14:08	74.3	30.00 in Hg	53.0

B.3 Emission Concentration Summaries

Emission Concentration Data

Job No.	101494.1.004.02
Client:	CCSI
Plant:	Gianera Generating Station
Location:	Gas Turbine Outlet
Operator:	Daniel Neal
Date:	18-Jul-00
Run No.	1
Condition:	100

	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	corrected for O_2: CO ppmv	corrected for O_2: TGOC as ppmv C_3H_8	corrected for O_2: NO_x as ppmv NO_2
Raw Avg.:	1.11	15.46	3.05	0.13	1.07			
Avg. Zero:	0.02	0.08	-0.04	-0.04	0.01			
Corr. Factor:	1.00792	1.00335	0.96940	0.99830	1.00050			
Corr. Avg.:	1.10	15.43	2.99	0.17	1.07	1.19		1.15
Minimum:	0.58	15.37	2.86	-0.07	1.03			
Maximum:	1.54	15.48	3.13	0.33	1.12			

	RAW DATA					CORRECTED DATA							
Time 24-Hr	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2			
7:01	0.59	15.44	3.16	0.29	1.1	0.58	15.42	3.10	0.33	1.10	0.62		1.18
7:02	0.92	15.42	3.17	0.24	1.07	0.91	15.40	3.11	0.28	1.07	0.98		1.14
7:03	0.96	15.46	3	0.22	1.07	0.95	15.44	2.94	0.26	1.07	1.03		1.15
7:04	0.93	15.49	2.94	0.21	1.05	0.92	15.47	2.88	0.25	1.05	1.00		1.14
7:05	1.16	15.49	2.94	0.19	1.05	1.15	15.47	2.88	0.23	1.05	1.25		1.14
7:06	1.2	15.48	2.92	0.2	1.06	1.19	15.46	2.86	0.24	1.06	1.29		1.14
7:07	1.18	15.47	2.93	0.2	1.06	1.17	15.45	2.87	0.24	1.06	1.27		1.14
7:08	1.38	15.49	2.94	0.18	1.07	1.38	15.47	2.88	0.22	1.07	1.49		1.16
7:09	1.16	15.49	2.94	0.18	1.11	1.15	15.47	2.88	0.22	1.11	1.25		1.20
7:10	0.68	15.45	3.14	0.13	1.11	0.67	15.43	3.08	0.17	1.11	0.72		1.19
7:11	0.94	15.39	3.16	0.14	1.1	0.93	15.37	3.10	0.18	1.10	0.99		1.17
7:12	0.95	15.43	3.19	0.12	1.09	0.94	15.41	3.13	0.16	1.09	1.01		1.17
7:13	0.98	15.41	3.19	0.14	1.09	0.97	15.39	3.13	0.18	1.09	1.04		1.16
7:14	1.02	15.44	3.17	0.1	1.06	1.01	15.42	3.11	0.14	1.06	1.09		1.14
7:15	1.17	15.43	3.17	0.09	1.05	1.16	15.41	3.11	0.13	1.05	1.25		1.12
7:16	1.13	15.43	3.11	0.12	1.03	1.12	15.41	3.05	0.16	1.03	1.21		1.10
7:17	1.43	15.48	2.99	0.13	1.04	1.43	15.46	2.93	0.17	1.04	1.55		1.12
7:18	1.25	15.47	2.97	0.13	1.08	1.24	15.45	2.91	0.17	1.08	1.35		1.16
7:19	0.71	15.49	2.96	0.12	1.09	0.70	15.47	2.90	0.16	1.09	0.76		1.18
7:20	1.01	15.48	2.96	0.12	1.06	1.00	15.46	2.90	0.16	1.06	1.09		1.14
7:21	1.09	15.5	2.95	0.13	1.05	1.08	15.48	2.89	0.17	1.05	1.18		1.14
7:22	1.15	15.48	2.95	0.12	1.05	1.14	15.46	2.89	0.16	1.05	1.24		1.13
7:23	1.18	15.45	3.07	0.11	1.05	1.17	15.43	3.01	0.15	1.05	1.27		1.13
7:24	1.54	15.41	3.15	0.09	1.06	1.54	15.39	3.09	0.13	1.06	1.64		1.13
7:25	1.43	15.41	3.15	0.09	1.05	1.43	15.39	3.09	0.13	1.05	1.53		1.12
7:26	1.52	15.42	3.15	-0.11	1.07	1.52	15.40	3.09	-0.07	1.07	1.63		1.14
7:27	0.91	15.44	3.14	0.09	1.12	0.90	15.42	3.08	0.13	1.12	0.97		1.20
7:28	0.89	15.44	3.17	0.09	1.11	0.88	15.42	3.11	0.13	1.11	0.95		1.19
7:29	0.98	15.41	3.15	0.1	1.11	0.97	15.39	3.09	0.14	1.11	1.04		1.18
7:30	1.27	15.49	2.98	0.11	1.09	1.26	15.47	2.92	0.15	1.09	1.37		1.18
7:31	1.36	15.49	2.95	0.1	1.09	1.36	15.47	2.89	0.14	1.09	1.47		1.18
7:32	1.4	15.49	2.93	0.11	1.07	1.40	15.47	2.87	0.15	1.07	1.52		1.16

Emission Concentration Data

Job No.	101494.1.004.02
Client:	CCSI
Plant:	Gianera Generating Station
Location:	Gas Turbine Outlet
Operator:	Daniel Neal
Date:	18-Jul-00
Run No.	2
Condition:	100

	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	corrected for O_2: CO ppmv	corrected for O_2: TGOC as ppmv C_3H_8	corrected for O_2: NO_x as ppmv NO_2
Raw Avg.:	1.54	15.48	3.03	0.09	1.07			
Avg. Zero:	0.00	0.11	0.05	-0.07	0.04			
Corr. Factor:	1.01150	1.00968	0.99834	1.00281	1.00956			
Corr. Avg.:	1.56	15.52	2.98	0.16	1.04	1.71		1.14
Minimum:	0.99	15.47	2.85	0.12	1.01			
Maximum:	1.96	15.58	3.14	0.20	1.11			

	RAW DATA					CORRECTED DATA							
Time 24-Hr	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2			
8:11	1.75	15.52	2.94	0.11	1.05	1.77	15.56	2.89	0.18	1.02	1.96		1.13
8:12	1.9	15.5	2.9	0.13	1.04	1.92	15.54	2.85	0.20	1.01	2.12		1.11
8:13	1.86	15.49	2.91	0.12	1.04	1.88	15.53	2.86	0.19	1.01	2.07		1.11
8:14	0.99	15.49	2.91	0.12	1.1	1.00	15.53	2.86	0.19	1.07	1.10		1.18
8:15	1.09	15.51	2.92	0.11	1.06	1.10	15.55	2.87	0.18	1.03	1.22		1.14
8:16	1.38	15.53	2.94	0.09	1.05	1.40	15.57	2.89	0.16	1.02	1.54		1.13
8:17	1.41	15.44	3.11	0.09	1.06	1.43	15.48	3.06	0.16	1.03	1.55		1.12
8:18	1.44	15.45	3.14	0.1	1.06	1.46	15.49	3.09	0.17	1.03	1.59		1.12
8:19	1.56	15.44	3.14	0.1	1.05	1.58	15.48	3.09	0.17	1.02	1.72		1.11
8:20	1.87	15.43	3.16	0.07	1.06	1.89	15.47	3.11	0.14	1.03	2.05		1.12
8:21	1.89	15.44	3.15	0.09	1.09	1.91	15.48	3.10	0.16	1.06	2.08		1.15
8:22	1.03	15.44	3.14	0.08	1.12	1.04	15.48	3.09	0.15	1.09	1.13		1.19
8:23	1.16	15.46	3.14	0.06	1.09	1.17	15.50	3.09	0.13	1.06	1.28		1.16
8:24	1.5	15.51	2.91	0.11	1.08	1.52	15.55	2.86	0.18	1.05	1.67		1.16
8:25	1.62	15.52	2.95	0.09	1.04	1.64	15.56	2.90	0.16	1.01	1.81		1.12
8:26	1.76	15.54	2.95	0.09	1.04	1.78	15.58	2.90	0.16	1.01	1.97		1.12
8:27	1.7	15.51	2.93	0.1	1.05	1.72	15.55	2.88	0.17	1.02	1.90		1.12
8:28	1.94	15.49	2.92	0.1	1.05	1.96	15.53	2.87	0.17	1.02	2.16		1.12
8:29	1.88	15.51	2.93	0.1	1.09	1.90	15.55	2.88	0.17	1.06	2.10		1.17
8:30	1.07	15.51	3.01	0.08	1.1	1.08	15.55	2.96	0.15	1.07	1.19		1.18
8:31	1.35	15.44	3.19	0.07	1.06	1.37	15.48	3.14	0.14	1.03	1.49		1.12
8:32	1.44	15.46	3.17	0.07	1.05	1.46	15.50	3.12	0.14	1.02	1.59		1.11
8:33	1.58	15.45	3.17	0.07	1.04	1.60	15.49	3.12	0.14	1.01	1.74		1.10
8:34	1.54	15.47	3.17	0.07	1.04	1.56	15.51	3.12	0.14	1.01	1.70		1.10
8:35	1.82	15.47	3.17	0.05	1.04	1.84	15.51	3.12	0.12	1.01	2.01		1.10
8:36	1.93	15.43	3.18	0.06	1.05	1.95	15.47	3.13	0.13	1.02	2.12		1.11
8:37	1.81	15.47	3.07	0.08	1.11	1.83	15.51	3.02	0.15	1.08	2.00		1.18
8:38	0.98	15.52	2.94	0.09	1.14	0.99	15.56	2.89	0.16	1.11	1.10		1.23
8:39	1.44	15.52	2.94	0.09	1.1	1.46	15.56	2.89	0.16	1.07	1.61		1.18
8:40	1.47	15.53	2.95	0.1	1.09	1.49	15.57	2.90	0.17	1.06	1.65		1.17
8:41	1.58	15.53	2.95	0.09	1.07	1.60	15.57	2.90	0.16	1.04	1.77		1.15
8:42	1.47	15.49	2.96	0.1	1.06	1.49	15.53	2.91	0.17	1.03	1.63		1.13

Emission Concentration Data

Job No.	101494.1.004.02
Client:	CCSI
Plant:	Gianera Generating Station
Location:	Gas Turbine Outlet
Operator:	Daniel Neal
Date:	18-Jul-00
Run No.	3
Condition:	100

	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	corrected for O_2: CO ppmv	corrected for O_2: TGOC as ppmv C_3H_8	corrected for O_2: NO_x as ppmv NO_2
Raw Avg.:	1.32	15.50	3.03	0.14	1.01			
Avg. Zero:	-0.04	0.13	0.14	-0.03	0.04			
Corr. Factor:	1.01339	1.00799	1.02906	1.00788	1.01827			
Corr. Avg.:	1.37	15.50	2.97	0.17	0.99	1.50		1.08
Minimum:	0.63	15.45	2.83	0.12	0.96			
Maximum:	1.92	15.56	3.14	0.21	1.06			

	RAW DATA					CORRECTED DATA							
Time 24-Hr	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2			
9:21	1.64	15.54	2.93	0.14	1	1.70	15.54	2.87	0.17	0.98	1.87		1.08
9:22	1.57	15.52	2.89	0.15	1	1.63	15.52	2.83	0.18	0.98	1.78		1.07
9:23	1.78	15.54	2.92	0.13	0.99	1.84	15.54	2.86	0.16	0.97	2.02		1.06
9:24	1.51	15.54	2.95	0.1	1.03	1.57	15.54	2.89	0.13	1.01	1.72		1.11
9:25	0.83	15.48	3.14	0.09	1.03	0.88	15.48	3.09	0.12	1.01	0.95		1.10
9:26	1.39	15.47	3.15	0.09	1.01	1.44	15.47	3.10	0.12	0.99	1.57		1.07
9:27	1.4	15.45	3.17	0.12	0.99	1.45	15.45	3.12	0.15	0.97	1.57		1.05
9:28	1.37	15.46	3.15	0.12	0.98	1.42	15.46	3.10	0.15	0.96	1.54		1.04
9:29	1.54	15.47	3.16	0.13	1	1.60	15.47	3.11	0.16	0.98	1.73		1.06
9:30	1.62	15.45	3.15	0.13	1	1.68	15.45	3.10	0.16	0.98	1.81		1.06
9:31	1.86	15.49	3.09	0.14	1.03	1.92	15.49	3.04	0.17	1.01	2.09		1.10
9:32	1.65	15.49	2.93	0.17	1.07	1.71	15.49	2.87	0.20	1.05	1.86		1.14
9:33	0.79	15.55	2.95	0.15	1.08	0.84	15.55	2.89	0.18	1.06	0.92		1.17
9:34	1.41	15.52	2.9	0.17	1.04	1.46	15.52	2.84	0.20	1.02	1.61		1.12
9:35	1.52	15.56	2.92	0.15	1.01	1.58	15.56	2.86	0.18	0.99	1.74		1.09
9:36	1.54	15.52	2.9	0.18	1	1.60	15.52	2.84	0.21	0.98	1.75		1.07
9:37	1.44	15.55	2.89	0.18	1	1.49	15.55	2.83	0.21	0.98	1.65		1.08
9:38	1.34	15.51	3.04	0.16	0.98	1.39	15.51	2.98	0.19	0.96	1.52		1.05
9:39	1.56	15.48	3.16	0.12	0.98	1.62	15.48	3.11	0.15	0.96	1.76		1.04
9:40	1.45	15.49	3.16	0.11	0.99	1.50	15.49	3.11	0.14	0.97	1.64		1.05
9:41	0.59	15.46	3.16	0.12	1.04	0.63	15.46	3.11	0.15	1.02	0.69		1.10
9:42	1.28	15.49	3.16	0.11	1.01	1.33	15.49	3.11	0.14	0.99	1.45		1.08
9:43	0.98	15.45	3.16	0.14	1.01	1.03	15.45	3.11	0.17	0.99	1.11		1.07
9:44	1.09	15.45	3.19	0.14	1.01	1.14	15.45	3.14	0.17	0.99	1.23		1.07
9:45	1.17	15.52	3.04	0.15	1.02	1.22	15.52	2.98	0.18	1.00	1.34		1.09
9:46	1.33	15.52	2.94	0.16	1.02	1.38	15.52	2.88	0.19	1.00	1.52		1.09
9:47	1.25	15.54	2.93	0.16	1.02	1.30	15.54	2.87	0.19	1.00	1.43		1.10
9:48	1.6	15.54	2.94	0.14	1.02	1.66	15.54	2.88	0.17	1.00	1.82		1.10
9:49	0.91	15.54	2.93	0.15	1.06	0.96	15.54	2.87	0.18	1.04	1.05		1.14
9:50	0.82	15.53	2.96	0.15	1.03	0.87	15.53	2.90	0.18	1.01	0.95		1.11
9:51	0.9	15.54	2.92	0.15	1.01	0.95	15.54	2.86	0.18	0.99	1.04		1.09
9:52	1.09	15.47	3.11	0.14	1	1.14	15.47	3.06	0.17	0.98	1.24		1.06

Emission Concentration Data

Job No.	101494.1.004.02
Client:	CCSI
Plant:	Gianera Generating Station
Location:	Gas Turbine Outlet
Operator:	Daniel Neal
Date:	18-Jul-00
Run No.	4
Condition:	100

	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	corrected for O_2: CO ppmv	corrected for O_2: TGOC as ppmv C_3H_8	corrected for O_2: NO_x as ppmv NO_2
Raw Avg.:	1.07	15.40	2.86	0.15	1.00			
Avg. Zero:	0.05	0.09	0.10	0.01	0.03			
Corr. Factor:	1.00100	1.00587	1.01518	0.99900	1.01313			
Corr. Avg.:	1.03	15.40	2.81	0.15	0.98	1.10		1.06
Minimum:	0.66	15.33	2.70	0.02	0.93			
Maximum:	1.38	15.46	2.96	0.23	1.04			

	RAW DATA					CORRECTED DATA							
Time 24-Hr	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2			
16:41	0.71	15.45	2.76	0.22	1.04	0.67	15.46	2.71	0.21	1.03	0.72		1.11
16:42	0.93	15.42	2.77	0.11	1.04	0.89	15.43	2.72	0.10	1.03	0.95		1.11
16:43	0.98	15.42	2.75	0.12	1.02	0.94	15.43	2.70	0.11	1.01	1.01		1.09
16:44	0.93	15.44	2.77	0.11	1	0.89	15.45	2.72	0.10	0.99	0.96		1.07
16:45	1.17	15.43	2.81	0.19	0.98	1.13	15.44	2.76	0.18	0.97	1.22		1.04
16:46	1.16	15.37	2.99	0.03	0.99	1.12	15.37	2.94	0.02	0.98	1.19		1.04
16:47	0.98	15.36	3.01	0.23	0.99	0.94	15.36	2.96	0.22	0.98	1.00		1.04
16:48	1.39	15.35	2.97	0.23	1	1.35	15.35	2.92	0.22	0.99	1.43		1.05
16:49	1.09	15.35	2.97	0.16	1.05	1.05	15.35	2.92	0.15	1.04	1.11		1.10
16:50	0.77	15.37	2.96	0.1	1.03	0.73	15.37	2.91	0.09	1.02	0.77		1.09
16:51	0.9	15.36	2.99	0.13	1.02	0.86	15.36	2.94	0.12	1.01	0.91		1.07
16:52	1.05	15.41	2.85	0.14	1.01	1.01	15.41	2.80	0.13	1.00	1.08		1.07
16:53	0.98	15.44	2.77	0.09	1.01	0.94	15.45	2.72	0.08	1.00	1.01		1.08
16:54	1.1	15.4	2.77	0.23	1.01	1.06	15.40	2.72	0.22	1.00	1.13		1.07
16:55	1.2	15.42	2.8	0.11	1	1.16	15.43	2.75	0.10	0.99	1.25		1.06
16:56	1.42	15.43	2.81	0.17	0.99	1.38	15.44	2.76	0.16	0.98	1.49		1.06
16:57	1.24	15.42	2.77	0.18	1.02	1.20	15.43	2.72	0.17	1.01	1.29		1.09
16:58	0.79	15.41	2.8	0.08	1.05	0.75	15.41	2.75	0.07	1.04	0.80		1.12
16:59	0.7	15.37	2.96	0.19	1	0.66	15.37	2.91	0.18	0.99	0.70		1.05
17:00	0.96	15.37	2.98	0.14	0.96	0.92	15.37	2.93	0.13	0.95	0.98		1.01
17:01	0.97	15.38	2.96	0.11	0.94	0.93	15.38	2.91	0.10	0.93	0.99		0.99
17:02	1.26	15.35	2.96	0.14	0.94	1.22	15.35	2.91	0.13	0.93	1.29		0.99
17:03	1.17	15.36	2.97	0.24	0.94	1.13	15.36	2.92	0.23	0.93	1.20		0.99
17:04	1.35	15.33	3	0.15	0.94	1.31	15.33	2.95	0.14	0.93	1.38		0.98
17:05	1.37	15.4	2.89	0.17	0.96	1.33	15.40	2.84	0.16	0.95	1.42		1.02
17:06	1.08	15.41	2.78	0.13	1.02	1.04	15.41	2.73	0.12	1.01	1.11		1.08
17:07	0.96	15.4	2.77	0.16	1	0.92	15.40	2.72	0.15	0.99	0.98		1.06
17:08	0.99	15.41	2.77	0.16	0.98	0.95	15.41	2.72	0.15	0.97	1.02		1.04
17:09	1.16	15.43	2.79	0.19	0.99	1.12	15.44	2.74	0.18	0.98	1.20		1.06
17:10	1.11	15.44	2.76	0.12	0.99	1.07	15.45	2.71	0.11	0.98	1.15		1.06
17:11	1.19	15.43	2.76	0.17	0.99	1.15	15.44	2.71	0.16	0.98	1.24		1.06
17:12	1.24	15.38	2.97	0.19	0.98	1.20	15.38	2.92	0.18	0.97	1.28		1.04

Emission Concentration Data

			CO	O_2	CO_2	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	corrected for O_2 CO	corrected for O_2 TGOC as ppmv C_3H_8	corrected for O_2 NO_x as ppmv NO_2
Job No.	101494.1.004.02		ppmv	percent	percent			ppmv		
Client:	CCSI	Raw Avg.:	0.96	15.39	2.90	0.15	1.05			
Plant:	Gianera Generating Station	Avg. Zero:	0.01	0.12	0.03	-0.03	0.03			
Location:	Gas Turbine Outlet	Corr. Factor:	1.00218	1.01139	0.98689	0.99810	1.01416			
Operator:	Daniel Neal	Corr. Avg.:	0.95	15.44	2.84	0.17	1.03	1.03		1.11
Date:	18-Jul-00	Minimum:	0.47	15.39	2.70	0.05	0.98			
Run No.	5	Maximum:	1.45	15.50	2.95	0.27	1.09			
Condition:	100									

	RAW DATA					CORRECTED DATA							
Time 24-Hr	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2			
17:51	0.48	15.36	2.96	0.14	1.05	0.47	15.41	2.90	0.16	1.03	0.51		1.11
17:52	0.73	15.37	2.99	0.15	1.02	0.72	15.42	2.93	0.17	1.00	0.78		1.08
17:53	0.7	15.36	3.01	0.12	1	0.69	15.41	2.95	0.14	0.98	0.74		1.06
17:54	0.74	15.37	2.97	0.14	1	0.73	15.42	2.91	0.16	0.98	0.79		1.06
17:55	0.77	15.39	2.97	0.23	1	0.76	15.44	2.91	0.25	0.98	0.82		1.06
17:56	0.9	15.38	2.97	0.14	1.01	0.89	15.43	2.91	0.16	0.99	0.96		1.07
17:57	0.91	15.38	2.91	0.15	1.04	0.90	15.43	2.85	0.17	1.02	0.97		1.11
17:58	0.96	15.45	2.8	0.14	1.05	0.95	15.50	2.74	0.16	1.03	1.04		1.13
17:59	0.85	15.42	2.79	0.14	1.09	0.84	15.47	2.73	0.16	1.08	0.92		1.17
18:00	0.68	15.42	2.78	0.19	1.09	0.67	15.47	2.72	0.21	1.08	0.73		1.17
18:01	0.79	15.42	2.78	0.14	1.07	0.78	15.47	2.72	0.16	1.05	0.85		1.15
18:02	0.83	15.41	2.8	0.14	1.1	0.82	15.46	2.74	0.16	1.09	0.89		1.18
18:03	1.09	15.43	2.76	0.16	1.05	1.08	15.48	2.70	0.18	1.03	1.18		1.13
18:04	1	15.37	2.94	0.12	1.05	0.99	15.42	2.88	0.14	1.03	1.07		1.11
18:05	1.18	15.38	2.96	0.19	1.04	1.17	15.43	2.90	0.21	1.02	1.27		1.11
18:06	1.38	15.37	2.99	0.13	1.03	1.37	15.42	2.93	0.15	1.01	1.48		1.09
18:07	1.46	15.35	2.99	0.16	1.05	1.45	15.40	2.93	0.18	1.03	1.56		1.11
18:08	0.67	15.35	2.99	0.18	1.08	0.66	15.40	2.93	0.20	1.06	0.71		1.14
18:09	0.78	15.37	2.99	0.1	1.04	0.77	15.42	2.93	0.12	1.02	0.83		1.10
18:10	1.07	15.36	2.93	0.09	1.03	1.06	15.41	2.87	0.11	1.01	1.14		1.09
18:11	1.07	15.4	2.81	0.24	1.03	1.06	15.45	2.75	0.26	1.01	1.15		1.10
18:12	1.19	15.44	2.76	0.19	1.04	1.18	15.49	2.70	0.21	1.02	1.29		1.12
18:13	1.16	15.44	2.76	0.25	1.03	1.15	15.49	2.70	0.27	1.01	1.26		1.11
18:14	1.28	15.45	2.76	0.17	1.02	1.27	15.50	2.70	0.19	1.00	1.39		1.10
18:15	1.3	15.42	2.78	0.22	1.04	1.29	15.47	2.72	0.24	1.02	1.41		1.11
18:16	0.91	15.42	2.78	0.14	1.09	0.90	15.47	2.72	0.16	1.08	0.98		1.17
18:17	0.73	15.39	2.93	0.15	1.08	0.72	15.44	2.87	0.17	1.06	0.78		1.15
18:18	0.87	15.37	2.98	0.1	1.06	0.86	15.42	2.92	0.12	1.04	0.93		1.13
18:19	0.97	15.35	3.01	0.17	1.06	0.96	15.40	2.95	0.19	1.04	1.03		1.12
18:20	1.05	15.34	3	0.11	1.05	1.04	15.39	2.94	0.13	1.03	1.12		1.11
18:21	1.04	15.37	2.97	0.03	1.05	1.03	15.42	2.91	0.05	1.03	1.11		1.11
18:22	1.23	15.36	2.97	0.05	1.04	1.22	15.41	2.91	0.07	1.02	1.31		1.10

Emission Concentration Data

Job No.	101494.1.004.02
Client:	CCSI
Plant:	Gianera Generating Station
Location:	Gas Turbine Outlet
Operator:	Daniel Neal
Date:	18-Jul-00
Run No.	6
Condition:	100

	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	corrected for O_2: CO ppmv	corrected for O_2: TGOC as ppmv C_3H_8	corrected for O_2: NO_x as ppmv NO_2
Raw Avg.:	1.18	15.39	2.89	0.11	1.05			
Avg. Zero:	0.06	0.10	0.03	-0.04	0.03			
Corr. Factor:	1.00420	1.01181	1.02730	0.99621	1.01467			
Corr. Avg.:	1.13	15.47	2.94	0.15	1.04	1.22		1.13
Minimum:	0.64	15.41	2.81	0.01	0.99			
Maximum:	1.64	15.53	3.08	0.21	1.11			

	RAW DATA					CORRECTED DATA							
Time 24-Hr	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2			
18:59	1.12	15.34	2.99	0.1	1.03	1.06	15.42	3.05	0.14	1.01	1.15		1.09
19:00	1.32	15.37	2.98	0.12	1.02	1.27	15.45	3.04	0.16	1.00	1.37		1.09
19:01	1.09	15.37	2.99	0.13	1.02	1.03	15.45	3.05	0.17	1.00	1.12		1.09
19:02	1.57	15.36	2.94	0.08	1.02	1.52	15.44	2.99	0.12	1.00	1.64		1.09
19:03	1.52	15.42	2.82	0.12	1.04	1.47	15.50	2.87	0.16	1.02	1.60		1.12
19:04	0.96	15.42	2.8	0.1	1.09	0.90	15.50	2.85	0.14	1.08	0.99		1.18
19:05	1.28	15.41	2.76	0.17	1.1	1.23	15.49	2.81	0.21	1.09	1.34		1.18
19:06	1.18	15.45	2.76	-0.03	1.07	1.12	15.53	2.81	0.01	1.06	1.24		1.16
19:07	1.2	15.42	2.77	0.17	1.05	1.14	15.50	2.82	0.21	1.03	1.25		1.13
19:08	1.29	15.42	2.78	0.11	1.02	1.24	15.50	2.83	0.15	1.00	1.35		1.10
19:09	1.2	15.36	2.92	0.14	1.03	1.14	15.44	2.97	0.18	1.01	1.24		1.10
19:10	1.06	15.38	2.99	0.11	1.06	1.00	15.46	3.05	0.15	1.05	1.09		1.13
19:11	0.94	15.37	2.99	0.07	1.06	0.88	15.45	3.05	0.11	1.05	0.96		1.13
19:12	1.24	15.35	3.02	0.1	1.07	1.18	15.43	3.08	0.14	1.06	1.28		1.14
19:13	0.93	15.37	2.98	0.11	1.12	0.87	15.45	3.04	0.15	1.11	0.95		1.20
19:14	0.7	15.37	2.97	0.09	1.08	0.64	15.45	3.03	0.13	1.07	0.70		1.15
19:15	1.16	15.37	2.92	0.15	1.06	1.10	15.45	2.97	0.19	1.05	1.20		1.13
19:16	0.9	15.42	2.78	0.13	1.06	0.84	15.50	2.83	0.17	1.05	0.92		1.14
19:17	1.08	15.41	2.78	0.14	1.06	1.02	15.49	2.83	0.18	1.05	1.12		1.14
19:18	1.13	15.43	2.77	0.12	1.06	1.07	15.51	2.82	0.16	1.05	1.18		1.14
19:19	1.29	15.42	2.78	0.12	1.05	1.24	15.50	2.83	0.16	1.03	1.35		1.13
19:20	1.49	15.41	2.79	0.13	1.04	1.44	15.49	2.84	0.17	1.02	1.57		1.12
19:21	1.19	15.39	2.82	0.1	1.09	1.13	15.47	2.87	0.14	1.08	1.23		1.17
19:22	0.98	15.38	2.91	0.1	1.06	0.92	15.46	2.96	0.14	1.05	1.00		1.13
19:23	1.19	15.35	2.96	0.1	1.03	1.13	15.43	3.02	0.14	1.01	1.22		1.09
19:24	1.07	15.36	2.97	0.07	1.03	1.01	15.44	3.03	0.11	1.01	1.10		1.10
19:25	1.28	15.37	3	0.11	1.04	1.23	15.45	3.06	0.16	1.02	1.33		1.11
19:26	1.51	15.33	2.97	0.06	1.04	1.46	15.41	3.03	0.10	1.02	1.56		1.10
19:27	1.69	15.38	2.99	0.15	1.01	1.64	15.46	3.05	0.19	0.99	1.78		1.08
19:28	1.53	15.36	2.96	0.16	1.04	1.48	15.44	3.02	0.20	1.02	1.60		1.11
19:29	0.95	15.42	2.82	0.09	1.07	0.89	15.50	2.87	0.13	1.06	0.98		1.15
19:30	0.76	15.41	2.8	0.09	1.03	0.70	15.49	2.85	0.13	1.01	0.77		1.11

Emission Concentration Data

Job No.	101494.1.004.02
Client:	CCSI
Plant:	Glanera Generating Station
Location:	Gas Turbine Outlet
Operator:	Daniel Neal
Date:	19-Jul-00
Run No.	7
Condition:	100

	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	corrected for O_2: CO ppmv	corrected for O_2: TGOC as ppmv C_3H_8	corrected for O_2: NO_x as ppmv NO_2
Raw Avg.:	1.01	15.35	2.87	0.15	1.12			
Avg. Zero:	-0.01	0.05	0.12	-0.03	0.01			
Corr. Factor:	1.00168	1.00587	1.05061	1.00251	1.01983			
Corr. Avg.:	1.02	15.39	2.89	0.18	1.14	1.10		1.22
Minimum:	0.53	15.34	2.73	0.04	1.10			
Maximum:	2.16	15.45	3.03	0.27	1.20			

	RAW DATA					CORRECTED DATA							
Time 24-Hr	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2			
6:41	0.9	15.33	2.88	0.16	1.15	0.91	15.37	2.90	0.19	1.16	0.97		1.24
6:42	0.73	15.34	2.97	0.17	1.14	0.74	15.38	3.00	0.20	1.15	0.79		1.23
6:43	1.04	15.33	2.97	0.15	1.13	1.05	15.37	3.00	0.18	1.14	1.12		1.22
6:44	1.11	15.3	3	0.21	1.12	1.12	15.34	3.03	0.24	1.13	1.19		1.20
6:45	1.03	15.32	2.97	0.21	1.12	1.04	15.36	3.00	0.24	1.13	1.11		1.21
6:46	1.17	15.31	2.97	0.11	1.12	1.18	15.35	3.00	0.14	1.13	1.26		1.20
6:47	1.16	15.33	2.91	0.18	1.17	1.17	15.37	2.94	0.21	1.18	1.25		1.26
6:48	0.75	15.38	2.71	0.13	1.19	0.76	15.43	2.73	0.16	1.20	0.82		1.30
6:49	1	15.38	2.75	0.24	1.15	1.01	15.43	2.77	0.27	1.16	1.09		1.25
6:50	0.99	15.39	2.72	0.19	1.14	1.00	15.44	2.74	0.22	1.15	1.08		1.24
6:51	1.05	15.37	2.73	0.17	1.13	1.06	15.41	2.75	0.20	1.14	1.14		1.23
6:52	0.98	15.36	2.71	0.16	1.13	0.99	15.40	2.73	0.19	1.14	1.06		1.23
6:53	1.02	15.39	2.77	0.14	1.11	1.03	15.44	2.79	0.17	1.12	1.11		1.21
6:54	0.98	15.32	2.88	0.16	1.1	0.99	15.36	2.90	0.19	1.11	1.06		1.18
6:55	1.09	15.31	2.96	0.18	1.09	1.10	15.35	2.99	0.21	1.10	1.17		1.17
6:56	1.11	15.31	2.96	0.09	1.12	1.12	15.35	2.99	0.12	1.13	1.19		1.20
6:57	0.52	15.3	2.96	0.15	1.14	0.53	15.34	2.99	0.18	1.15	0.56		1.22
6:58	0.73	15.31	2.99	0.08	1.11	0.74	15.35	3.02	0.11	1.12	0.79		1.19
6:59	0.89	15.35	2.96	0.15	1.1	0.90	15.39	2.99	0.18	1.11	0.97		1.19
7:00	0.97	15.34	2.96	0.17	1.09	0.98	15.38	2.99	0.20	1.10	1.05		1.18
7:01	0.91	15.39	2.72	0.1	1.1	0.92	15.44	2.74	0.13	1.11	0.99		1.20
7:02	0.68	15.4	2.73	0.14	1.1	0.69	15.45	2.75	0.17	1.11	0.75		1.20
7:03	1.54	15.36	2.75	0.18	1.11	1.55	15.40	2.77	0.21	1.12	1.67		1.20
7:04	2.15	15.4	2.75	0.16	1.1	2.16	15.45	2.77	0.19	1.11	2.34		1.20
7:05	0.62	15.4	2.73	0.14	1.14	0.63	15.45	2.75	0.17	1.15	0.68		1.25
7:06	0.81	15.38	2.71	0.11	1.19	0.82	15.43	2.73	0.14	1.20	0.89		1.30
7:07	1.04	15.36	2.85	0.12	1.15	1.05	15.40	2.87	0.15	1.16	1.13		1.25
7:08	1.11	15.33	2.99	0.21	1.12	1.12	15.37	3.02	0.24	1.13	1.20		1.21
7:09	1.24	15.35	2.96	0.07	1.12	1.25	15.39	2.99	0.10	1.13	1.34		1.21
7:10	1.3	15.34	2.95	0.01	1.11	1.31	15.38	2.98	0.04	1.12	1.40		1.20
7:11	0.81	15.32	2.95	0.18	1.1	0.82	15.36	2.98	0.21	1.11	0.88		1.18
7:12	0.97	15.32	2.98	0.17	1.1	0.98	15.36	3.01	0.20	1.11	1.05		1.18

Emission Concentration Data

Job No.	101494.1.004.02
Client:	CCSI
Plant:	Gianera Generating Station
Location:	Gas Turbine Outlet
Operator:	Daniel Neal
Date:	19-Jul-00
Run No.	8
Condition:	100

	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	corrected for O_2: CO ppmv	corrected for O_2: TGOC as ppmv C_3H_8	corrected for O_2: NO_x as ppmv NO_2
Raw Avg.:	0.96	15.38	2.86	0.10	1.08			
Avg. Zero:	0.02	0.10	0.06	-0.03	0.03			
Corr. Factor:	1.00521	1.00756	1.00333	1.00930	1.04100			
Corr. Avg.:	0.95	15.40	2.81	0.13	1.09	1.02		1.17
Minimum:	0.56	15.35	2.64	0.01	1.05			
Maximum:	1.29	15.45	2.95	0.19	1.15			

	RAW DATA					CORRECTED DATA							
Time 24-Hr	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2			
7:46	1.1	15.38	2.73	0.16	1.08	1.09	15.40	2.68	0.19	1.10	1.17		1.18
7:47	1.26	15.35	2.9	0.07	1.06	1.25	15.37	2.85	0.10	1.08	1.34		1.15
7:48	1.15	15.36	2.97	0.07	1.08	1.14	15.38	2.92	0.10	1.10	1.22		1.17
7:49	0.87	15.33	2.96	0.1	1.13	0.86	15.35	2.91	0.13	1.15	0.91		1.22
7:50	0.81	15.33	2.96	0.11	1.1	0.80	15.35	2.91	0.14	1.12	0.85		1.19
7:51	0.86	15.35	2.95	0.11	1.08	0.85	15.37	2.90	0.14	1.10	0.91		1.17
7:52	0.89	15.35	2.95	0.09	1.08	0.88	15.37	2.90	0.12	1.10	0.94		1.17
7:53	1.01	15.36	2.93	0.11	1.08	1.00	15.38	2.88	0.14	1.10	1.07		1.17
7:54	1.05	15.41	2.72	0.12	1.09	1.04	15.43	2.67	0.15	1.11	1.12		1.20
7:55	1.07	15.4	2.75	0.1	1.09	1.06	15.42	2.70	0.13	1.11	1.14		1.19
7:56	1.22	15.4	2.74	0.15	1.09	1.21	15.42	2.69	0.18	1.11	1.30		1.19
7:57	1.27	15.4	2.74	0.13	1.1	1.26	15.42	2.69	0.16	1.12	1.36		1.21
7:58	0.59	15.39	2.73	0.1	1.13	0.58	15.41	2.68	0.13	1.15	0.62		1.24
7:59	0.86	15.42	2.72	0.13	1.09	0.85	15.44	2.67	0.16	1.11	0.92		1.20
8:00	0.94	15.39	2.87	0.04	1.05	0.93	15.41	2.82	0.07	1.07	1.00		1.15
8:01	0.9	15.34	2.97	0.12	1.05	0.89	15.36	2.92	0.15	1.07	0.95		1.14
8:02	0.94	15.35	2.97	0.09	1.04	0.93	15.37	2.92	0.12	1.06	0.99		1.13
8:03	1.03	15.36	2.97	0.09	1.03	1.02	15.38	2.92	0.12	1.05	1.09		1.12
8:04	1.09	15.34	2.97	0.12	1.03	1.08	15.36	2.92	0.15	1.05	1.15		1.11
8:05	1.15	15.34	2.99	0.08	1.04	1.14	15.36	2.94	0.11	1.06	1.22		1.13
8:06	0.68	15.35	2.95	0.07	1.09	0.67	15.37	2.90	0.10	1.11	0.71		1.18
8:07	0.75	15.4	2.74	0.13	1.08	0.74	15.42	2.69	0.16	1.10	0.80		1.18
8:08	0.89	15.42	2.73	0.11	1.07	0.88	15.44	2.68	0.14	1.09	0.95		1.18
8:09	0.96	15.43	2.71	0.09	1.06	0.95	15.45	2.66	0.12	1.08	1.03		1.17
8:10	0.95	15.43	2.74	0.1	1.07	0.94	15.45	2.69	0.13	1.09	1.02		1.18
8:11	0.98	15.43	2.7	0.13	1.07	0.97	15.45	2.65	0.16	1.09	1.05		1.18
8:12	1.05	15.42	2.69	0.13	1.07	1.04	15.44	2.64	0.16	1.09	1.12		1.18
8:13	1.3	15.41	2.75	0.12	1.07	1.29	15.43	2.70	0.15	1.09	1.39		1.17
8:14	1.16	15.35	2.95	0.11	1.07	1.15	15.37	2.90	0.14	1.09	1.23		1.16
8:15	0.57	15.36	3	0.1	1.11	0.56	15.38	2.95	0.13	1.13	0.60		1.21
8:16	0.73	15.37	2.98	0.13	1.07	0.72	15.39	2.93	0.16	1.09	0.77		1.16
8:17	0.75	15.38	2.98	-0.02	1.05	0.74	15.40	2.93	0.01	1.07	0.79		1.14

Emission Concentration Data

Job No.	101494.1.004.02
Client:	CCSI
Plant:	Glanera Generating Station
Location:	Gas Turbine Outlet
Operator:	Daniel Neal
Date:	19-Jul-00
Run No.	9
Condition:	100

	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	corrected for O_2: CO ppmv	corrected for O_2: TGOC as ppmv C_3H_8	corrected for O_2: NO_x as ppmv NO_2
Raw Avg.:	1.08	15.41	2.84	0.36	1.02			
Avg. Zero:	0.00	0.13	0.03	0.17	0.03			
Corr. Factor:	1.01099	1.01139	0.99176	1.01918	1.05191			
Corr. Avg.:	1.09	15.46	2.79	0.20	1.04	1.19		1.13
Minimum:	0.63	15.39	2.64	-0.04	1.00			
Maximum:	1.68	15.50	2.94	0.28	1.08			

	RAW DATA					CORRECTED DATA							
Time 24-Hr	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2			
8:51	0.97	15.44	2.69	0.19	1.03	0.98	15.48	2.64	0.02	1.05	1.07		1.15
8:52	0.91	15.46	2.69	0.13	1.03	0.92	15.50	2.64	-0.04	1.05	1.01		1.15
8:53	0.99	15.45	2.69	0.19	1.03	1.00	15.49	2.64	0.02	1.05	1.09		1.15
8:54	0.89	15.4	2.93	0.13	1.01	0.90	15.44	2.88	-0.04	1.03	0.97		1.11
8:55	1.27	15.39	2.94	0.18	1.01	1.28	15.43	2.89	0.01	1.03	1.39		1.11
8:56	1.29	15.37	2.96	0.35	1.01	1.30	15.41	2.91	0.18	1.03	1.40		1.11
8:57	1.05	15.38	2.96	0.39	1.06	1.06	15.42	2.91	0.22	1.08	1.14		1.17
8:58	0.68	15.38	2.96	0.39	1.05	0.69	15.42	2.91	0.22	1.07	0.74		1.16
8:59	1.01	15.39	2.96	0.39	1.02	1.02	15.43	2.91	0.22	1.04	1.10		1.12
9:00	1.18	15.38	2.92	0.39	1.02	1.19	15.42	2.87	0.22	1.04	1.29		1.12
9:01	0.98	15.44	2.75	0.41	1.02	0.99	15.48	2.70	0.24	1.04	1.08		1.13
9:02	1.18	15.43	2.76	0.4	0.99	1.19	15.47	2.71	0.23	1.01	1.30		1.10
9:03	1.24	15.44	2.73	0.4	0.99	1.25	15.48	2.68	0.23	1.01	1.37		1.10
9:04	1.33	15.44	2.71	0.42	0.99	1.34	15.48	2.66	0.25	1.01	1.46		1.10
9:05	1.19	15.45	2.73	0.39	1.02	1.20	15.49	2.68	0.22	1.04	1.31		1.14
9:06	0.62	15.46	2.71	0.4	1.03	0.63	15.50	2.66	0.23	1.05	0.69		1.15
9:07	0.99	15.43	2.86	0.37	1	1.00	15.47	2.81	0.20	1.02	1.09		1.11
9:08	1	15.39	2.96	0.39	0.98	1.01	15.43	2.91	0.22	1.00	1.09		1.08
9:09	1.02	15.39	2.96	0.38	0.98	1.03	15.43	2.91	0.21	1.00	1.11		1.08
9:10	1.02	15.4	2.98	0.39	0.98	1.03	15.44	2.93	0.22	1.00	1.12		1.08
9:11	1.23	15.37	2.97	0.38	0.98	1.24	15.41	2.92	0.21	1.00	1.34		1.07
9:12	1.21	15.35	2.99	0.39	1	1.22	15.39	2.94	0.22	1.02	1.31		1.09
9:13	1.01	15.37	2.97	0.38	1.04	1.02	15.41	2.92	0.21	1.06	1.10		1.14
9:14	1.11	15.44	2.79	0.4	1.05	1.12	15.48	2.74	0.23	1.07	1.22		1.17
9:15	1.21	15.44	2.73	0.41	1.03	1.22	15.48	2.68	0.24	1.05	1.33		1.15
9:16	1.05	15.46	2.73	0.43	1.03	1.06	15.50	2.68	0.26	1.05	1.16		1.15
9:17	1.23	15.43	2.71	0.43	1.04	1.24	15.47	2.66	0.26	1.06	1.35		1.16
9:18	1.14	15.45	2.73	0.43	1.03	1.15	15.49	2.68	0.26	1.05	1.26		1.15
9:19	0.95	15.45	2.7	0.44	1.02	0.96	15.49	2.65	0.28	1.04	1.05		1.14
9:20	1.66	15.44	2.71	0.44	1.02	1.68	15.48	2.66	0.28	1.04	1.83		1.13
9:21	1.2	15.37	2.92	0.43	1.04	1.21	15.41	2.87	0.26	1.06	1.30		1.14
9:22	0.82	15.39	2.93	0.43	1.05	0.83	15.43	2.88	0.26	1.07	0.89		1.16

Emission Concentration Data

Job No.	101494.1.004.02
Client:	CCSI
Plant:	Glanera Generating Station
Location:	Gas Turbine Outlet
Operator:	Daniel Neal
Date:	19-Jul-00
Run No.	10
Condition:	100

	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	corrected for O_2: CO ppmv	corrected for O_2: TGOC as ppmv C_3H_8	corrected for O_2: NO_x as ppmv NO_2
Raw Avg.:	1.71	15.41	2.83	0.32	1.03			
Avg. Zero:	-0.03	0.13	0.01	0.20	0.03			
Corr. Factor:	1.00996	1.01310	0.98527	1.02263	1.04046			
Corr. Avg.:	1.76	15.48	2.78	0.12	1.04	1.91		1.14
Minimum:	0.95	15.44	2.61	-0.12	0.99			
Maximum:	2.44	15.55	2.93	0.34	1.11			

	RAW DATA					CORRECTED DATA							
Time 24-Hr	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	CO ppmv	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2
11:21	1.76	15.38	2.94	0.49	1.05	1.80	15.45	2.89	0.30	1.07	1.95		1.15
11:22	1.42	15.4	2.95	0.48	1.02	1.46	15.47	2.90	0.29	1.04	1.59		1.12
11:23	1.73	15.38	2.98	0.49	1	1.77	15.45	2.93	0.30	1.01	1.92		1.10
11:24	1.85	15.39	2.96	0.48	0.99	1.89	15.46	2.91	0.29	1.00	2.05		1.09
11:25	2.01	15.38	2.91	0.49	0.99	2.06	15.45	2.86	0.30	1.00	2.22		1.09
11:26	2.14	15.42	2.87	0.48	0.99	2.19	15.49	2.82	0.29	1.00	2.38		1.10
11:27	2.39	15.44	2.68	0.52	1.02	2.44	15.51	2.63	0.33	1.04	2.67		1.13
11:28	1.4	15.46	2.7	0.49	1.07	1.44	15.53	2.65	0.30	1.09	1.58		1.19
11:29	1.46	15.45	2.66	0.53	1.06	1.50	15.52	2.61	0.34	1.08	1.64		1.18
11:30	1.74	15.43	2.68	0.46	1.03	1.78	15.50	2.63	0.27	1.05	1.95		1.14
11:31	1.92	15.45	2.69	0.28	1.03	1.96	15.52	2.64	0.08	1.05	2.15		1.15
11:32	1.92	15.46	2.71	0.3	1	1.96	15.53	2.66	0.10	1.01	2.16		1.11
11:33	2.12	15.39	2.84	0.24	1	2.17	15.46	2.79	0.04	1.01	2.35		1.10
11:34	2.21	15.39	2.93	0.25	1	2.26	15.46	2.88	0.05	1.01	2.45		1.10
11:35	1.61	15.38	2.93	0.24	1.04	1.65	15.45	2.88	0.04	1.06	1.79		1.14
11:36	1.22	15.39	2.94	0.26	1.03	1.26	15.46	2.89	0.06	1.05	1.36		1.13
11:37	1.56	15.42	2.95	0.25	1.01	1.60	15.49	2.90	0.05	1.02	1.75		1.12
11:38	1.72	15.4	2.9	0.26	0.99	1.76	15.47	2.85	0.06	1.00	1.91		1.09
11:39	1.92	15.38	2.91	0.26	0.98	1.96	15.45	2.86	0.06	0.99	2.13		1.08
11:40	2.21	15.46	2.68	0.28	0.99	2.26	15.53	2.63	0.08	1.00	2.48		1.10
11:41	2.2	15.45	2.68	0.24	1.01	2.25	15.52	2.63	0.04	1.02	2.46		1.12
11:42	1.27	15.44	2.72	0.23	1.08	1.31	15.51	2.67	0.03	1.10	1.43		1.20
11:43	1.22	15.48	2.7	0.28	1.06	1.26	15.55	2.65	0.08	1.08	1.39		1.19
11:44	1.51	15.44	2.68	0.24	1.05	1.55	15.51	2.63	0.04	1.07	1.70		1.17
11:45	1.69	15.46	2.7	0.23	1.04	1.73	15.53	2.65	0.03	1.06	1.90		1.16
11:46	1.62	15.41	2.8	0.25	1.05	1.66	15.48	2.75	0.05	1.07	1.81		1.16
11:47	1.62	15.39	2.94	0.19	1.05	1.66	15.46	2.89	-0.01	1.07	1.80		1.16
11:48	2	15.4	2.92	0.25	1.04	2.05	15.47	2.87	0.05	1.06	2.22		1.15
11:49	1.73	15.37	2.92	0.26	1.07	1.77	15.44	2.87	0.06	1.09	1.92		1.17
11:50	0.92	15.41	2.92	0.08	1.09	0.95	15.48	2.87	-0.12	1.11	1.04		1.21
11:51	1.35	15.37	2.96	0.24	1.04	1.39	15.44	2.91	0.04	1.06	1.50		1.14
11:52	1.37	15.39	2.91	0.21	1.04	1.41	15.46	2.86	0.01	1.06	1.53		1.15

Emission Concentration Data

Job No.	101494.1.004.02
Client:	CCSI
Plant:	Gianera Generating Station
Location:	Gas Turbine Outlet
Operator:	Daniel Neal
Date:	19-Jul-00
Run No.	11
Condition:	100

	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	corrected for O_2: CO ppmv	corrected for O_2: TGOC as ppmv C_3H_8	corrected for O_2: NO_x as ppmv NO_2
Raw Avg.:	1.69	15.43	2.80	0.23	1.02			
Avg. Zero:	-0.03	0.09	0.13	0.06	0.01			
Corr. Factor:	1.00656	1.00756	1.07117	1.02483	1.02661			
Corr. Avg.:	1.73	15.46	2.86	0.18	1.04	1.88		1.12
Minimum:	0.99	15.40	2.71	0.04	1.01			
Maximum:	2.36	15.51	3.05	0.25	1.09			

	RAW DATA					CORRECTED DATA							
Time 24-Hr	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2			
12:31	1.22	15.39	2.94	0.25	1.05	1.26	15.42	3.01	0.19	1.07	1.35		1.15
12:32	1.4	15.41	2.85	0.23	1.03	1.44	15.44	2.91	0.17	1.05	1.56		1.13
12:33	1.82	15.43	2.69	0.29	1.01	1.86	15.46	2.74	0.24	1.03	2.02		1.11
12:34	1.88	15.46	2.67	0.25	1	1.92	15.49	2.72	0.19	1.02	2.10		1.11
12:35	2.03	15.46	2.67	0.24	0.99	2.07	15.49	2.72	0.18	1.01	2.26		1.10
12:36	2.08	15.44	2.66	0.24	1	2.12	15.47	2.71	0.18	1.02	2.31		1.10
12:37	2.19	15.46	2.69	0.25	1.03	2.23	15.49	2.74	0.19	1.05	2.44		1.14
12:38	1.24	15.45	2.7	0.24	1.06	1.28	15.48	2.75	0.18	1.08	1.39		1.17
12:39	1.42	15.4	2.86	0.26	1.03	1.46	15.43	2.92	0.20	1.05	1.57		1.13
12:40	1.73	15.41	2.94	0.2	1.01	1.77	15.44	3.01	0.14	1.03	1.91		1.11
12:41	1.62	15.41	2.96	0.21	1	1.66	15.44	3.03	0.15	1.02	1.79		1.10
12:42	1.84	15.37	2.98	0.22	0.99	1.88	15.40	3.05	0.16	1.01	2.02		1.08
12:43	2.07	15.39	2.92	0.23	0.99	2.11	15.42	2.99	0.17	1.01	2.28		1.08
12:44	2.15	15.38	2.92	0.2	1	2.19	15.41	2.99	0.14	1.02	2.36		1.09
12:45	1.34	15.43	2.84	0.22	1.06	1.38	15.46	2.90	0.16	1.08	1.50		1.17
12:46	1.38	15.46	2.7	0.23	1.04	1.42	15.49	2.75	0.17	1.06	1.55		1.15
12:47	1.53	15.46	2.67	0.21	1.02	1.57	15.49	2.72	0.15	1.04	1.71		1.13
12:48	1.52	15.48	2.68	0.27	1.02	1.56	15.51	2.73	0.22	1.04	1.71		1.14
12:49	1.55	15.46	2.68	0.22	1.02	1.59	15.49	2.73	0.16	1.04	1.73		1.13
12:50	1.68	15.47	2.69	0.29	1	1.72	15.50	2.74	0.24	1.02	1.88		1.11
12:51	1.82	15.45	2.72	0.26	1.01	1.86	15.48	2.77	0.20	1.03	2.03		1.12
12:52	1.57	15.38	2.84	0.25	1.04	1.61	15.41	2.90	0.19	1.06	1.73		1.14
12:53	0.95	15.39	2.92	0.22	1.07	0.99	15.42	2.99	0.16	1.09	1.06		1.17
12:54	1.25	15.38	2.91	0.26	1.02	1.29	15.41	2.98	0.20	1.04	1.38		1.11
12:55	1.5	15.4	2.91	0.24	1	1.54	15.43	2.98	0.18	1.02	1.66		1.10
12:56	1.72	15.38	2.91	0.19	1	1.76	15.41	2.98	0.13	1.02	1.89		1.09
12:57	1.96	15.37	2.9	0.2	1	2.00	15.40	2.97	0.14	1.02	2.15		1.09
12:58	2.3	15.4	2.88	0.21	1	2.35	15.43	2.95	0.15	1.02	2.53		1.10
12:59	2.31	15.47	2.68	0.21	1.03	2.36	15.50	2.73	0.15	1.05	2.57		1.14
13:00	1.33	15.44	2.72	0.3	1.06	1.37	15.47	2.77	0.25	1.08	1.49		1.17
13:01	1.76	15.47	2.7	0.1	1.02	1.80	15.50	2.75	0.04	1.04	1.97		1.13
13:02	1.97	15.46	2.69	0.28	1	2.01	15.49	2.74	0.23	1.02	2.20		1.11

Emission Concentration Data

Job No.	101494.1.004.02
Client:	CCSI
Plant:	Gianera Generating Station
Location:	Gas Turbine Outlet
Operator:	Daniel Neal
Date:	19-Jul-00
Run No.	12
Condition:	100

	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	corrected for O_2: CO ppmv	corrected for O_2: TGOC as ppmv C_3H_8	corrected for O_2: NO_x as ppmv NO_2
Raw Avg.:	1.28	15.43	2.79	0.22	1.02			
Avg. Zero:	-0.05	0.08	0.23	0.04	0.01			
Corr. Factor:	1.00521	1.00883	1.15992	1.02662	1.02714			
Corr. Avg.:	1.34	15.49	2.97	0.19	1.04	1.46		1.13
Minimum:	0.80	15.43	2.82	0.14	0.99			
Maximum:	1.99	15.54	3.14	0.26	1.11			

	RAW DATA					CORRECTED DATA							
Time 24-Hr	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2	CO ppmv	O_2 percent	CO_2 percent	TGOC as ppmv C_3H_8	NO_x as ppmv NO_2			
13:37	1.46	15.42	2.94	0.23	1.01	1.51	15.48	3.14	0.20	1.03	1.65		1.12
13:38	1.42	15.41	2.71	0.29	1.03	1.47	15.47	2.88	0.26	1.05	1.60		1.14
13:39	1.73	15.48	2.67	0.27	1	1.78	15.54	2.83	0.24	1.02	1.96		1.12
13:40	1.62	15.46	2.66	0.27	1.01	1.67	15.52	2.82	0.24	1.03	1.83		1.13
13:41	1.88	15.45	2.7	0.23	1.02	1.94	15.51	2.87	0.20	1.04	2.12		1.13
13:42	1.31	15.47	2.69	0.23	1.08	1.36	15.53	2.85	0.20	1.10	1.50		1.21
13:43	0.89	15.44	2.68	0.25	1.09	0.94	15.50	2.84	0.22	1.11	1.03		1.21
13:44	1.05	15.45	2.73	0.22	1.07	1.10	15.51	2.90	0.19	1.09	1.20		1.19
13:45	0.99	15.39	2.92	0.2	1.05	1.04	15.45	3.12	0.17	1.07	1.13		1.16
13:46	0.95	15.37	2.94	0.22	1.04	1.00	15.43	3.14	0.19	1.06	1.08		1.14
13:47	1.06	15.4	2.91	0.21	1.04	1.11	15.46	3.11	0.18	1.06	1.20		1.15
13:48	1.2	15.4	2.9	0.21	1.03	1.25	15.46	3.10	0.18	1.05	1.36		1.14
13:49	1.18	15.39	2.9	0.19	1.04	1.23	15.45	3.10	0.16	1.06	1.33		1.14
13:50	1.2	15.41	2.92	0.17	1.05	1.25	15.47	3.12	0.14	1.07	1.36		1.16
13:51	0.75	15.43	2.78	0.19	1.08	0.80	15.49	2.96	0.16	1.10	0.87		1.20
13:52	0.8	15.46	2.68	0.24	1.05	0.85	15.52	2.84	0.21	1.07	0.93		1.17
13:53	1.01	15.46	2.69	0.22	1.03	1.06	15.52	2.85	0.19	1.05	1.16		1.15
13:54	1.01	15.47	2.69	0.18	1.02	1.06	15.53	2.85	0.15	1.04	1.16		1.14
13:55	1.26	15.47	2.72	0.2	0.99	1.31	15.53	2.89	0.17	1.01	1.44		1.11
13:56	1.43	15.47	2.68	0.23	0.98	1.48	15.53	2.84	0.20	1.00	1.63		1.09
13:57	1.9	15.45	2.7	0.22	0.97	1.96	15.51	2.87	0.19	0.99	2.14		1.08
13:58	1.32	15.41	2.89	0.21	1.02	1.37	15.47	3.09	0.18	1.04	1.49		1.13
13:59	0.94	15.39	2.92	0.2	1.04	0.99	15.45	3.12	0.17	1.06	1.07		1.14
14:00	1.29	15.4	2.91	0.22	0.99	1.34	15.46	3.11	0.19	1.01	1.45		1.09
14:01	1.4	15.41	2.89	0.2	0.98	1.45	15.47	3.09	0.17	1.00	1.58		1.08
14:02	1.4	15.4	2.91	0.21	0.98	1.45	15.46	3.11	0.18	1.00	1.57		1.08
14:03	1.51	15.4	2.91	0.21	0.98	1.56	15.46	3.11	0.18	1.00	1.69		1.08
14:04	1.67	15.44	2.85	0.27	0.97	1.72	15.50	3.04	0.24	0.99	1.88		1.08
14:05	1.93	15.45	2.69	0.23	0.99	1.99	15.51	2.85	0.20	1.01	2.17		1.10
14:06	1.27	15.48	2.69	0.23	1.02	1.32	15.54	2.85	0.20	1.04	1.45		1.14
14:07	0.92	15.47	2.69	0.22	1.02	0.97	15.53	2.85	0.19	1.04	1.06		1.14
14:08	1.34	15.45	2.69	0.23	0.99	1.39	15.51	2.85	0.20	1.01	1.52		1.10

B.4 Turbine Process Data

Date	Time	Inlet temp, F	Catalyst inlet temp., F	Catalyst outlet temp., F	Discharge pressure, psi	Discharge temp., F	Exhaust gas temp., F	Electrical power, kW	Fuel flow rate, lb/hr
7/18/00	07:10:00	62	896	1560	132	670	979	1387.0	942.70
7/18/00	07:11:00	62	896	1558	132	672	979	1384.3	940.60
7/18/00	07:12:00	62	895	1558	132	672	979	1382.4	940.30
7/18/00	07:13:00	62	895	1558	132	672	981	1385.6	942.20
7/18/00	07:14:00	62	895	1556	132	672	981	1380.6	941.70
7/18/00	07:15:00	62	895	1556	132	672	981	1384.3	941.80
7/18/00	07:16:00	62	895	1556	132	672	981	1390.0	942.00
7/18/00	07:17:00	62	895	1556	132	672	981	1386.0	947.70
7/18/00	07:18:00	62	897	1558	132	672	981	1385.6	944.30
7/18/00	07:19:00	62	895	1560	132	672	979	1386.6	946.00
7/18/00	07:20:00	62	895	1556	132	672	979	1387.6	942.20
7/18/00	07:21:00	62	895	1558	132	672	979	1386.6	942.80
7/18/00	07:22:00	62	895	1556	132	672	979	1387.8	945.60
7/18/00	07:23:00	62	895	1556	132	672	979	1392.6	944.00
7/18/00	07:24:00	62	895	1556	132	672	979	1387.1	945.60
7/18/00	07:25:00	62	895	1554	132	672	981	1387.9	943.40
7/18/00	07:26:00	62	895	1556	132	672	981	1392.0	946.50
7/18/00	07:27:00	62	895	1560	132	672	979	1394.7	946.70
7/18/00	07:28:00	62	895	1560	132	672	981	1390.1	946.40
7/18/00	07:29:00	62	895	1556	132	672	979	1388.3	946.10
7/18/00	07:30:00	62	895	1558	132	672	981	1389.7	940.30
7/18/00	07:31:00	62	895	1556	132	672	981	1388.2	945.00
7/18/00	07:32:00	62	895	1556	132	672	981	1391.6	946.10
7/18/00	07:33:00	62	895	1556	132	672	981	1387.1	942.60
7/18/00	07:34:00	62	895	1554	132	672	981	1384.8	946.10
7/18/00	07:35:00	62	895	1556	132	672	981	1388.6	942.50
7/18/00	07:36:00	62	895	1562	132	672	979	1390.4	946.30
7/18/00	07:37:00	62	895	1556	132	672	979	1386.6	941.70
7/18/00	07:38:00	62	895	1556	132	672	981	1384.8	941.30
7/18/00	07:39:00	62	895	1556	132	672	981	1384.6	942.80
7/18/00	07:40:00	62	895	1556	132	672	981	1383.4	943.20
7/18/00	07:41:00	62	895	1554	132	672	981	1382.4	941.50
7/18/00	07:42:00	62	897	1556	132	672	981	1382.4	941.10
Averages:		62	895.2	1556.8	132	671.9	980.2	1387.0	943.61

Date	Time	Inlet temp, F	Catalyst inlet temp., F	Catalyst outlet temp., F	Discharge pressure, psi	Discharge temp., F	Exhaust gas temp., F	Electrical power, kW	Fuel flow rate, lb/hr
7/18/00	08:20:00	62	896	1557	132	672	981	1379.1	936.8
7/18/00	08:21:00	62	896	1555	132	672	981	1381.9	937.2
7/18/00	08:22:00	62	896	1557	132	672	981	1384.6	939.4
7/18/00	08:23:00	62	896	1563	132	672	981	1385.5	940.7
7/18/00	08:24:00	62	894	1557	132	672	981	1384.4	937.2
7/18/00	08:25:00	62	894	1557	132	672	981	1379.2	940.1
7/18/00	08:26:00	62	895	1557	132	672	981	1380.9	939.4
7/18/00	08:27:00	62	895	1555	132	672	981	1382.1	938.8
7/18/00	08:28:00	62	895	1555	132	672	981	1380.7	940.1
7/18/00	08:29:00	64	895	1557	132	672	981	1378.7	940.4
7/18/00	08:30:00	64	895	1557	132	672	981	1379.2	938
7/18/00	08:31:00	64	895	1561	132	672	981	1375.9	938.3
7/18/00	08:32:00	64	895	1557	132	672	981	1375.3	937.3
7/18/00	08:33:00	64	895	1557	132	672	981	1375.3	938.1
7/18/00	08:34:00	62	895	1555	132	672	981	1378.5	934.8
7/18/00	08:35:00	64	897	1557	132	674	981	1378.9	936.5
7/18/00	08:36:00	64	897	1555	132	672	981	1376.8	935.7
7/18/00	08:37:00	64	895	1557	132	674	981	1377.9	939.1
7/18/00	08:38:00	64	897	1559	132	672	981	1372.4	939.9
7/18/00	08:39:00	64	895	1559	132	672	981	1371.2	937.1
7/18/00	08:40:00	64	895	1557	132	674	981	1371.1	934.3
7/18/00	08:41:00	64	895	1557	132	674	981	1369.8	935.6
7/18/00	08:42:00	64	895	1555	130	674	981	1369	936.9
7/18/00	08:43:00	64	895	1555	130	674	981	1370.4	936.6
7/18/00	08:44:00	64	895	1555	130	674	981	1368.2	935.6
7/18/00	08:45:00	64	895	1555	130	674	983	1371.3	935.4
7/18/00	08:46:00	64	897	1559	130	674	981	1368.4	933.8
7/18/00	08:47:00	64	895	1561	130	674	981	1369.3	935
7/18/00	08:48:00	64	895	1557	130	674	981	1369.4	933
7/18/00	08:49:00	64	895	1557	130	674	981	1374.9	936.5
7/18/00	08:50:00	64	895	1557	130	674	981	1371.7	938.7
7/18/00	08:51:00	64	895	1555	130	674	981	1374.4	936.8
7/18/00	08:52:00	64	895	1557	130	674	983	1369.1	933.2
Averages:		63.4	895.3	1557	131.3	672.9	981.1	1375.6	937.2

Date	Time	Inlet temp, F	Catalyst inlet temp., F	Catalyst outlet temp., F	Discharge pressure, psi	Discharge temp., F	Exhaust gas temp., F	Electrical power, kW	Fuel flow rate, lb/hr
7/18/00	09:30:00	64	896	1556	130	674	983	1362.8	933.4
7/18/00	09:31:00	64	896	1556	130	674	983	1359.5	931.9
7/18/00	09:32:00	64	896	1558	130	674	983	1366.7	937.1
7/18/00	09:33:00	64	896	1560	130	674	983	1367.8	934.1
7/18/00	09:34:00	64	896	1560	130	674	983	1366.3	934.4
7/18/00	09:35:00	64	894	1556	130	674	981	1363.9	934.1
7/18/00	09:36:00	64	896	1556	130	674	983	1364.2	931.3
7/18/00	09:37:00	64	896	1556	130	674	983	1361.9	931.2
7/18/00	09:38:00	64	896	1556	130	674	983	1361.6	932.4
7/18/00	09:39:00	64	896	1556	130	674	983	1363.8	935.1
7/18/00	09:40:00	64	896	1556	130	674	983	1362.7	930.6
7/18/00	09:41:00	66	896	1560	130	674	983	1361.5	932.9
7/18/00	09:42:00	66	896	1562	130	674	983	1362.9	931.6
7/18/00	09:43:00	66	896	1558	130	674	981	1356.9	932.7
7/18/00	09:44:00	66	896	1556	130	674	983	1360.7	931.3
7/18/00	09:45:00	66	896	1558	130	676	983	1360.9	930.5
7/18/00	09:46:00	66	895	1556	130	676	983	1363.9	935.1
7/18/00	09:47:00	66	897	1556	130	676	983	1359.5	935.1
7/18/00	09:48:00	66	895	1556	130	676	983	1362.1	931.2
7/18/00	09:49:00	66	895	1558	130	676	983	1362.1	934.6
7/18/00	09:50:00	66	895	1564	130	674	983	1362	934.5
7/18/00	09:51:00	66	895	1556	130	676	981	1357.3	929.2
7/18/00	09:52:00	66	897	1558	130	676	983	1350.1	931.1
7/18/00	09:53:00	66	895	1558	130	676	983	1356	930
7/18/00	09:54:00	66	895	1556	130	676	983	1356.7	931.3
7/18/00	09:55:00	66	897	1558	130	676	983	1354.1	932.2
7/18/00	09:56:00	66	895	1558	130	676	983	1351.5	927.8
7/18/00	09:57:00	66	895	1558	130	676	985	1350.7	926.3
7/18/00	09:58:00	66	897	1564	130	676	983	1353.1	931.4
7/18/00	09:59:00	66	895	1558	130	676	983	1353	932.2
7/18/00	10:00:00	66	897	1558	130	676	983	1347.4	929.3
7/18/00	10:01:00	66	895	1558	130	676	983	1346.5	928.4
7/18/00	10:02:00	66	897	1558	130	676	983	1344.2	926.5
Averages:		65.3	895.8	1557.8	130	675.0	982.9	1358.6	931.8

Date	Time	Inlet temp, F	Catalyst inlet temp., F	Catalyst outlet temp., F	Discharge pressure, psi	Discharge temp., F	Exhaust gas temp., F	Electrical power, kW	Fuel flow rate, lb/hr
7/18/00	16:15:00	78	904	1561	126	686	993	1254	896.1
7/18/00	16:16:00	78	904	1562	126	686	993	1248.2	897.2
7/18/00	16:17:00	78	904	1568	126	686	993	1257.1	891.6
7/18/00	16:18:00	78	904	1566	126	686	993	1243.1	892.2
7/18/00	16:19:00	78	904	1564	126	686	993	1242.1	892.5
7/18/00	16:20:00	78	906	1564	126	688	993	1245.8	890.3
7/18/00	16:21:00	78	904	1564	126	688	993	1245.5	893
7/18/00	16:22:00	78	904	1562	126	688	993	1243.4	895.3
7/18/00	16:23:00	78	904	1562	126	686	995	1247.3	894.1
7/18/00	16:24:00	78	904	1562	126	686	993	1248.6	894.5
7/18/00	16:25:00	76	904	1564	126	686	993	1252.3	893.5
7/18/00	16:26:00	76	904	1568	126	686	993	1244.9	895.2
7/18/00	16:27:00	78	904	1562	126	686	993	1244.4	892.7
7/18/00	16:28:00	78	904	1562	126	686	993	1242.8	898.6
7/18/00	16:29:00	78	902	1562	126	686	995	1246	896.3
7/18/00	16:30:00	78	904	1562	126	686	993	1243.7	892.6
7/18/00	16:31:00	78	902	1560	126	686	993	1247.5	898.6
7/18/00	16:32:00	78	902	1560	126	686	995	1247.7	895.5
7/18/00	16:33:00	78	904	1564	126	686	993	1247.8	897.7
7/18/00	16:34:00	78	902	1564	126	686	993	1247	897.4
7/18/00	16:35:00	78	902	1560	126	686	993	1245.9	895
7/18/00	16:36:00	78	902	1560	126	686	993	1242.6	893.7
7/18/00	16:37:00	78	902	1560	126	686	995	1243.5	891.9
7/18/00	16:38:00	78	900	1560	126	688	995	1245	893.6
7/18/00	16:39:00	78	903	1562	126	686	995	1247.7	895.7
7/18/00	16:40:00	78	903	1562	126	686	995	1241.9	896.7
7/18/00	16:41:00	78	903	1564	126	686	995	1247.2	896
7/18/00	16:42:00	78	901	1564	126	686	993	1244.5	895.5
7/18/00	16:43:00	78	901	1560	126	686	993	1241.5	892.3
7/18/00	16:44:00	78	901	1560	126	686	993	1242.5	892.5
7/18/00	16:45:00	78	903	1562	126	688	993	1240.9	893.8
7/18/00	16:46:00	78	903	1560	126	688	995	1244	894.1
7/18/00	16:47:00	78	903	1560	126	688	995	1244.2	890.4
Averages:		77.9	903.1	1562.3	126	686.4	993.6	1245.8	894.4

Date	Time	Inlet temp, F	Catalyst inlet temp., F	Catalyst outlet temp., F	Discharge pressure, psi	Discharge temp., F	Exhaust gas temp., F	Electrical power, kW	Fuel flow rate, lb/hr
7/18/00	18:00:00	78	906	1567	126	686	993	1244.1	890.5
7/18/00	18:01:00	78	906	1565	126	686	993	1240.6	890.7
7/18/00	18:02:00	78	906	1567	126	686	995	1244	894.2
7/18/00	18:03:00	76	907	1567	126	686	993	1242.3	891.3
7/18/00	18:04:00	76	907	1567	126	686	995	1242.6	891.7
7/18/00	18:05:00	76	905	1567	126	686	995	1246.4	891.5
7/18/00	18:06:00	76	907	1566	126	686	995	1244.2	888.7
7/18/00	18:07:00	76	907	1570	126	686	995	1247.4	891.8
7/18/00	18:08:00	76	905	1568	126	686	993	1246.5	892.4
7/18/00	18:09:00	76	905	1566	126	686	993	1240.6	892.8
7/18/00	18:10:00	78	905	1564	126	686	993	1244.5	890.6
7/18/00	18:11:00	78	902	1561	126	686	993	1241.6	891.9
7/18/00	18:12:00	78	902	1563	126	686	993	1244.4	893.1
7/18/00	18:13:00	78	902	1561	126	686	993	1246.4	892.8
7/18/00	18:14:00	78	900	1563	126	686	993	1250.7	895
7/18/00	18:15:00	78	900	1561	126	686	993	1247.3	895.1
7/18/00	18:16:00	78	900	1567	126	686	993	1250.3	894.9
7/18/00	18:17:00	76	900	1563	126	686	991	1251.7	894.7
7/18/00	18:18:00	78	900	1561	126	686	993	1243.1	890.7
7/18/00	18:19:00	78	900	1561	126	686	993	1244.6	893.2
7/18/00	18:20:00	78	900	1561	126	686	993	1245.1	891.3
7/18/00	18:21:00	78	900	1561	126	686	993	1247.5	892.9
7/18/00	18:22:00	76	900	1561	126	686	993	1248.1	893
7/18/00	18:23:00	76	900	1561	126	686	993	1249.1	893.5
7/18/00	18:24:00	76	902	1567	126	686	993	1245.1	893.8
7/18/00	18:25:00	78	902	1565	126	686	993	1240.3	890.4
7/18/00	18:26:00	78	900	1563	126	686	993	1243.8	893.3
7/18/00	18:27:00	76	900	1563	126	686	993	1246	893.8
7/18/00	18:28:00	76	902	1561	126	686	993	1248.9	895.8
7/18/00	18:29:00	76	902	1561	126	686	993	1250	895.3
7/18/00	18:30:00	76	902	1561	126	686	993	1248.4	895.2
7/18/00	18:31:00	76	900	1561	126	686	993	1252.8	897
7/18/00	18:32:00	76	900	1565	126	686	993	1258.9	896.2
Averages:		77.0	902.5	1563.8	126	686	993.2	1246.3	893.0

Date	Time	Inlet temp, F	Catalyst inlet temp., F	Catalyst outlet temp., F	Discharge pressure, psi	Discharge temp., F	Exhaust gas temp., F	Electrical power, kW	Fuel flow rate, lb/hr
7/18/00	19:08:00	74	898	1558	126	684	991	1275.9	903.5
7/18/00	19:09:00	74	898	1558	126	684	989	1275.1	905.5
7/18/00	19:10:00	74	898	1558	126	684	989	1274.5	905.5
7/18/00	19:11:00	74	896	1558	126	684	991	1277.9	904.9
7/18/00	19:12:00	74	896	1562	126	682	991	1275.5	907
7/18/00	19:13:00	74	894	1562	126	682	989	1272.8	902.3
7/18/00	19:14:00	72	896	1560	126	682	989	1276.5	907
7/18/00	19:15:00	72	896	1558	126	682	989	1278	907.3
7/18/00	19:16:00	72	896	1558	126	682	989	1277.6	902.8
7/18/00	19:17:00	72	896	1560	126	682	991	1279.5	906.8
7/18/00	19:18:00	74	900	1562	126	684	991	1276.4	904.1
7/18/00	19:19:00	72	900	1562	126	682	991	1273.7	904.6
7/18/00	19:20:00	72	900	1562	126	682	991	1284.5	905.1
7/18/00	19:21:00	72	900	1567	126	682	989	1284.1	905.8
7/18/00	19:22:00	72	900	1563	126	682	989	1277.7	900.5
7/18/00	19:23:00	72	902	1561	126	682	989	1280	902.3
7/18/00	19:24:00	72	900	1561	126	682	989	1279.6	901.5
7/18/00	19:25:00	72	900	1561	126	682	989	1278.7	905
7/18/00	19:26:00	72	902	1561	126	682	989	1280.5	900.8
7/18/00	19:27:00	72	900	1559	126	682	989	1279	906.8
7/18/00	19:28:00	72	900	1559	126	682	989	1281.4	902.6
7/18/00	19:29:00	72	898	1563	126	682	989	1286.4	910.3
7/18/00	19:30:00	72	896	1559	126	682	987	1281.4	906.3
7/18/00	19:31:00	72	896	1557	126	682	989	1281.8	905
7/18/00	19:32:00	72	896	1559	126	682	989	1286.7	906.4
7/18/00	19:33:00	72	896	1557	128	682	989	1286	911.3
7/18/00	19:34:00	72	896	1557	128	682	989	1284.6	911.3
7/18/00	19:35:00	72	896	1557	128	682	989	1286.3	912.8
7/18/00	19:36:00	72	898	1561	128	682	989	1294.8	915.2
7/18/00	19:37:00	72	898	1565	128	680	987	1293.5	912.3
7/18/00	19:38:00	72	896	1559	128	680	987	1292.8	913.6
7/18/00	19:39:00	72	896	1557	128	682	987	1292.3	912.8
7/18/00	19:40:00	72	896	1557	128	682	987	1288.7	914.2
Averages:		72.4	897.8	1559.9	126.5	682.2	989.1	1281.6	906.8

Date	Time	Inlet temp, F	Catalyst inlet temp., F	Catalyst outlet temp., F	Discharge pressure, psi	Discharge temp., F	Exhaust gas temp., F	Electrical power, kW	Fuel flow rate, lb/hr
7/19/00	06:50:00	60	895	1554	132	670	979	1398.6	949.6
7/19/00	06:51:00	60	895	1554	132	670	979	1397.4	945.8
7/19/00	06:52:00	60	897	1554	132	670	979	1396.4	945.9
7/19/00	06:53:00	60	895	1552	132	670	979	1397.4	946.2
7/19/00	06:54:00	60	895	1554	132	670	979	1398.8	947.7
7/19/00	06:55:00	60	895	1554	132	670	979	1400.4	945.3
7/19/00	06:56:00	60	897	1560	132	670	979	1397.3	945.3
7/19/00	06:57:00	60	895	1556	132	670	979	1397.6	946.7
7/19/00	06:58:00	60	895	1554	132	670	979	1395.6	945.7
7/19/00	06:59:00	60	895	1554	132	670	979	1400.2	948.4
7/19/00	07:00:00	60	895	1554	132	670	979	1393.9	947.4
7/19/00	07:01:00	60	895	1554	132	670	979	1398	944.6
7/19/00	07:02:00	60	895	1554	132	670	979	1395.9	944.2
7/19/00	07:03:00	60	897	1554	132	670	979	1393	944.1
7/19/00	07:04:00	60	895	1554	132	670	979	1397.6	942.9
7/19/00	07:05:00	60	897	1560	132	670	979	1397.1	944
7/19/00	07:06:00	60	897	1558	132	670	979	1392.7	944.2
7/19/00	07:07:00	60	897	1556	132	670	979	1394.9	946.3
7/19/00	07:08:00	60	895	1554	132	670	979	1393.2	946
7/19/00	07:09:00	60	896	1554	132	670	979	1397.5	943.4
7/19/00	07:10:00	60	896	1554	132	672	979	1394	939.8
7/19/00	07:11:00	60	896	1554	132	672	979	1393	945.3
7/19/00	07:12:00	60	896	1554	132	670	979	1394.2	945.5
7/19/00	07:13:00	60	896	1554	132	670	979	1397.6	942.9
7/19/00	07:14:00	60	896	1560	132	670	979	1395.6	943.2
7/19/00	07:15:00	60	896	1556	132	670	979	1392.6	942.8
7/19/00	07:16:00	60	896	1554	132	670	979	1392.8	939.2
7/19/00	07:17:00	60	896	1554	132	670	979	1392.5	946.2
7/19/00	07:18:00	60	896	1554	132	670	979	1391.5	939.6
7/19/00	07:19:00	60	896	1554	132	670	979	1389.6	943.7
7/19/00	07:20:00	60	896	1554	132	670	979	1394.3	942.2
7/19/00	07:21:00	60	896	1554	132	672	979	1394.5	941.7
7/19/00	07:22:00	62	896	1554	132	670	979	1390	939.4
Averages:		60.1	895.8	1554.8	132	670.2	979	1395.3	944.4

Date	Time	Inlet temp, F	Catalyst inlet temp., F	Catalyst outlet temp., F	Discharge pressure, psi	Discharge temp., F	Exhaust gas temp., F	Electrical power, kW	Fuel flow rate, lb/hr
7/19/00	07:55:00	62	897	1555	132	672	981	1383.1	935.8
7/19/00	07:56:00	62	897	1555	132	672	981	1385.1	936.9
7/19/00	07:57:00	62	897	1559	132	672	981	1386.3	937.9
7/19/00	07:58:00	62	895	1557	132	672	979	1383.3	937.8
7/19/00	07:59:00	62	897	1555	132	672	979	1380.7	938.3
7/19/00	08:00:00	62	895	1555	132	672	981	1384.3	937.6
7/19/00	08:01:00	62	895	1555	132	672	981	1381	936.9
7/19/00	08:02:00	62	897	1555	132	672	981	1381.8	938.6
7/19/00	08:03:00	62	896	1555	132	672	981	1382.6	936.5
7/19/00	08:04:00	62	896	1555	132	672	981	1378.3	936.2
7/19/00	08:05:00	62	896	1555	132	672	981	1381.1	935.9
7/19/00	08:06:00	62	896	1561	132	672	981	1382.3	939.4
7/19/00	08:07:00	62	896	1557	132	672	981	1379.4	940.5
7/19/00	08:08:00	62	896	1555	132	672	981	1376.7	934.7
7/19/00	08:09:00	62	896	1555	132	672	981	1379.4	937.6
7/19/00	08:10:00	62	896	1553	132	674	981	1373.1	938.6
7/19/00	08:11:00	62	896	1555	132	672	981	1379.7	938.5
7/19/00	08:12:00	62	896	1555	132	672	981	1380.8	942.5
7/19/00	08:13:00	62	896	1555	132	672	981	1380.7	936.2
7/19/00	08:14:00	64	896	1555	132	674	981	1379.7	937.5
7/19/00	08:15:00	64	896	1559	132	672	981	1379.3	937.4
7/19/00	08:16:00	62	894	1555	132	672	979	1377.4	936.1
7/19/00	08:17:00	62	896	1555	132	674	981	1378	939.3
7/19/00	08:18:00	62	896	1557	132	672	981	1375.6	936.7
7/19/00	08:19:00	62	896	1555	132	674	981	1375.4	937.1
7/19/00	08:20:00	64	894	1555	132	674	981	1373.5	939.4
7/19/00	08:21:00	64	896	1553	130	674	981	1373	935.2
7/19/00	08:22:00	64	898	1555	130	674	981	1375	936.9
7/19/00	08:23:00	64	896	1560	130	674	981	1377.1	939.6
7/19/00	08:24:00	64	896	1558	130	672	981	1374.1	936.3
7/19/00	08:25:00	64	896	1554	130	672	981	1371.9	935.3
7/19/00	08:26:00	64	896	1554	130	674	981	1370.3	934.3
7/19/00	08:27:00	64	896	1556	130	674	981	1374.4	938.4
Averages:		62.6	896	1555.7	131.6	672.6	980.8	1378.6	937.5

Date	Time	Inlet temp, F	Catalyst inlet temp., F	Catalyst outlet temp., F	Discharge pressure, psi	Discharge temp., F	Exhaust gas temp., F	Electrical power, kW	Fuel flow rate, lb/hr
7/19/00	09:00:00	64	897	1555	130	674	981	1360.3	935.3
7/19/00	09:01:00	64	897	1555	130	674	983	1359.5	933.3
7/19/00	09:02:00	64	895	1555	130	674	983	1356.9	933.3
7/19/00	09:03:00	64	897	1555	130	674	983	1358.2	933.3
7/19/00	09:04:00	64	897	1555	130	674	983	1361.5	932.4
7/19/00	09:05:00	64	897	1555	130	674	983	1361.2	933.9
7/19/00	09:06:00	64	897	1563	130	674	983	1361.1	929.5
7/19/00	09:07:00	64	895	1555	130	674	981	1360.8	932.7
7/19/00	09:08:00	64	895	1557	130	674	983	1360.5	934.3
7/19/00	09:09:00	64	897	1553	130	674	983	1358.6	936.9
7/19/00	09:10:00	64	897	1555	130	676	983	1360.4	937.1
7/19/00	09:11:00	64	895	1555	130	676	983	1360.6	934.6
7/19/00	09:12:00	64	895	1555	130	674	983	1360.4	932.2
7/19/00	09:13:00	66	895	1553	130	674	983	1361.2	931.4
7/19/00	09:14:00	66	897	1563	130	674	983	1362.6	929.1
7/19/00	09:15:00	66	895	1555	130	674	983	1358.8	932.2
7/19/00	09:16:00	66	895	1555	130	674	981	1359.7	930.1
7/19/00	09:17:00	64	897	1555	130	674	983	1354.3	933
7/19/00	09:18:00	66	895	1555	130	674	983	1356.3	933.6
7/19/00	09:19:00	66	895	1553	130	676	983	1353.8	932.2
7/19/00	09:20:00	64	895	1553	130	674	983	1358	934.1
7/19/00	09:21:00	66	895	1553	130	674	983	1359.6	927.8
7/19/00	09:22:00	66	897	1563	130	674	983	1356.8	933.7
7/19/00	09:23:00	66	895	1555	130	674	983	1349.3	931
7/19/00	09:24:00	66	897	1557	130	674	983	1354.3	931.8
7/19/00	09:25:00	66	897	1555	130	674	983	1353.2	934
7/19/00	09:26:00	66	897	1555	130	676	983	1353.4	931.9
7/19/00	09:27:00	66	897	1555	130	674	983	1351.6	930.4
7/19/00	09:28:00	66	897	1555	130	676	983	1351.1	931
7/19/00	09:29:00	66	897	1555	130	676	983	1348.2	927.4
7/19/00	09:30:00	66	897	1563	130	674	983	1354.7	931.5
7/19/00	09:31:00	66	895	1555	130	674	983	1349.5	932.9
7/19/00	09:32:00	66	897	1555	130	676	983	1348	930.8
verages:		65.1	896.2	1555.8	130	674.4	982.8	1356.8	932.4

Date	Time	Inlet temp, F	Catalyst inlet temp., F	Catalyst outlet temp., F	Discharge pressure, psi	Discharge temp., F	Exhaust gas temp., F	Electrical power, kW	Fuel flow rate, lb/hr
7/19/00	11:30:00	72	898	1557	128	680	987	1304.9	910.5
7/19/00	11:31:00	72	896	1555	128	680	987	1304.8	912
7/19/00	11:32:00	72	896	1553	128	680	987	1307.1	912.5
7/19/00	11:33:00	72	898	1553	128	680	987	1305.6	914.8
7/19/00	11:34:00	72	898	1553	128	680	989	1307.2	909.4
7/19/00	11:35:00	72	898	1555	128	680	989	1300.4	908
7/19/00	11:36:00	72	898	1557	128	682	989	1305.5	910.5
7/19/00	11:37:00	72	896	1557	128	680	987	1304.9	906.3
7/19/00	11:38:00	72	898	1555	128	680	987	1303.1	906
7/19/00	11:39:00	72	898	1553	128	682	989	1294.2	908.9
7/19/00	11:40:00	72	898	1555	128	682	989	1301.6	907.3
7/19/00	11:41:00	72	898	1553	128	680	987	1302.1	907.9
7/19/00	11:42:00	72	898	1553	128	682	989	1302.8	912.8
7/19/00	11:43:00	72	898	1555	128	680	989	1302.7	907
7/19/00	11:44:00	72	898	1559	128	680	989	1300.9	908.7
7/19/00	11:45:00	72	898	1555	128	680	989	1297.4	910.2
7/19/00	11:46:00	72	898	1555	128	680	987	1300.9	909.9
7/19/00	11:47:00	72	898	1553	128	682	989	1299.1	906.1
7/19/00	11:48:00	72	898	1553	128	682	989	1297.2	908.3
7/19/00	11:49:00	72	898	1553	128	682	989	1304.7	910.4
7/19/00	11:50:00	72	898	1559	128	680	989	1308.4	910.5
7/19/00	11:51:00	72	898	1559	128	680	989	1300.4	908.1
7/19/00	11:52:00	72	898	1555	128	680	989	1299.7	904.5
7/19/00	11:53:00	72	898	1553	128	682	989	1293.1	900
7/19/00	11:54:00	72	900	1557	128	682	989	1296.2	906.5
7/19/00	11:55:00	72	900	1557	128	682	989	1298	906.6
7/19/00	11:56:00	72	900	1555	128	682	989	1292	904.6
7/19/00	11:57:00	72	900	1555	128	682	989	1298.6	905.7
7/19/00	11:58:00	72	900	1561	128	682	989	1301.4	903.8
7/19/00	11:59:00	72	898	1559	128	682	989	1297.7	903.5
7/19/00	12:00:00	74	900	1555	128	682	989	1296.6	906.2
7/19/00	12:01:00	72	900	1555	128	682	989	1298.4	904.9
7/19/00	12:02:00	72	900	1553	128	682	989	1292.8	908.4
Averages:		72.1	898.3	1555.3	128	681.0	988.5	1300.6	907.9

Date	Time	Inlet temp, F	Catalyst inlet temp., F	Catalyst outlet temp., F	Discharge pressure, psi	Discharge temp., F	Exhaust gas temp., F	Electrical power, kW	Fuel flow rate, lb/hr
7/19/00	12:40:00	76	896	1558	128	682	991	1282.4	904.6
7/19/00	12:41:00	76	896	1554	128	682	989	1277.4	903.4
7/19/00	12:42:00	76	898	1554	128	684	991	1276.5	904.1
7/19/00	12:43:00	76	898	1555	128	684	991	1279.5	901.6
7/19/00	12:44:00	76	898	1553	128	684	991	1283.5	905.7
7/19/00	12:45:00	74	898	1555	128	684	991	1282.9	902.9
7/19/00	12:46:00	74	898	1559	128	684	991	1281.2	901.2
7/19/00	12:47:00	74	898	1559	128	682	989	1282.7	902.4
7/19/00	12:48:00	74	896	1555	128	682	989	1277.7	902.7
7/19/00	12:49:00	74	898	1555	128	684	991	1280.1	906.8
7/19/00	12:50:00	74	898	1555	128	684	991	1281.3	900.1
7/19/00	12:51:00	74	898	1555	128	684	991	1283.4	901
7/19/00	12:52:00	76	898	1555	128	684	991	1279.8	898.7
7/19/00	12:53:00	76	898	1557	128	684	991	1284.6	898.6
7/19/00	12:54:00	76	898	1559	126	684	991	1282	897.6
7/19/00	12:55:00	76	898	1553	126	684	989	1275.3	897.4
7/19/00	12:56:00	76	898	1555	126	684	991	1273.5	898.4
7/19/00	12:57:00	76	900	1557	126	684	991	1269.4	896.5
7/19/00	12:58:00	76	902	1559	126	684	991	1272.9	895.8
7/19/00	12:59:00	76	900	1557	126	684	991	1274.5	899.4
7/19/00	13:00:00	76	900	1557	126	684	993	1270.9	896.3
7/19/00	13:01:00	76	900	1563	126	684	991	1267.9	898.2
7/19/00	13:02:00	76	900	1559	126	684	991	1272.7	895.1
7/19/00	13:03:00	76	900	1557	126	684	991	1267.2	895.8
7/19/00	13:04:00	76	900	1555	126	684	991	1264.2	895.7
7/19/00	13:05:00	76	898	1555	126	686	993	1263.7	897.4
7/19/00	13:06:00	76	898	1555	126	686	993	1263.8	897.2
7/19/00	13:07:00	76	898	1555	126	686	993	1263.2	896.8
7/19/00	13:08:00	76	898	1560	126	684	991	1270.5	898
7/19/00	13:09:00	76	898	1556	126	684	991	1269.4	898.9
7/19/00	13:10:00	78	896	1554	126	684	991	1269.5	895.9
7/19/00	13:11:00	78	898	1554	126	684	991	1268.2	893.4
7/19/00	13:12:00	78	898	1554	126	684	991	1266.9	898.9
Averages:		75.8	898.3	1556.2	126.8	683.9	991	1274.5	899.3

Date	Time	Inlet temp, F	Catalyst inlet temp., F	Catalyst outlet temp., F	Discharge pressure, psi	Discharge temp., F	Exhaust gas temp., F	Electrical power, kW	Fuel flow rate, lb/hr
7/19/00	13:46:00	76	898	1554	126	684	991	1269.1	899.3
7/19/00	13:47:00	76	900	1556	126	684	991	1268.2	899.8
7/19/00	13:48:00	76	900	1556	126	684	991	1273.5	899
7/19/00	13:49:00	76	898	1556	126	684	991	1273.8	898.9
7/19/00	13:50:00	76	900	1558	126	684	993	1271.7	896.9
7/19/00	13:51:00	76	900	1562	126	684	991	1275.4	900.7
7/19/00	13:52:00	76	900	1560	126	684	991	1267.2	896.1
7/19/00	13:53:00	76	902	1560	126	684	991	1264.5	893.9
7/19/00	13:54:00	76	904	1560	126	684	991	1270	898.2
7/19/00	13:55:00	76	904	1560	126	686	991	1264.7	897.7
7/19/00	13:56:00	76	904	1560	126	684	991	1267.4	894.7
7/19/00	13:57:00	76	904	1560	126	684	991	1268.8	896.7
7/19/00	13:58:00	76	906	1562	126	684	993	1268.5	896.3
7/19/00	13:59:00	76	904	1566	126	684	991	1269.9	896.6
7/19/00	14:00:00	76	904	1564	126	684	991	1268.8	897.6
7/19/00	14:01:00	76	904	1562	126	684	991	1263.8	895.2
7/19/00	14:02:00	76	904	1560	126	684	991	1266.5	893.1
7/19/00	14:03:00	76	904	1558	126	686	991	1264.3	894.5
7/19/00	14:04:00	76	901	1558	126	684	991	1268.8	901.8
7/19/00	14:05:00	76	901	1556	126	684	991	1264.5	901
7/19/00	14:06:00	76	899	1558	126	684	993	1265.1	898
7/19/00	14:07:00	76	901	1560	126	684	991	1260.3	897.1
7/19/00	14:08:00	76	899	1558	126	684	991	1260	897.3
7/19/00	14:09:00	76	897	1556	126	684	991	1264.8	899.9
7/19/00	14:10:00	76	897	1556	126	684	991	1266.1	898.4
7/19/00	14:11:00	76	897	1556	126	684	991	1265.3	907.2
7/19/00	14:12:00	78	897	1556	126	686	993	1260.3	900.4
7/19/00	14:13:00	78	897	1556	126	686	993	1263.5	901.4
7/19/00	14:14:00	78	897	1558	126	686	993	1261.2	899.3
7/19/00	14:15:00	78	897	1562	126	684	991	1266.2	901.4
7/19/00	14:16:00	78	897	1556	126	684	991	1259.8	896.2
7/19/00	14:17:00	78	897	1556	126	684	991	1266.9	902.5
7/19/00	14:18:00	78	897	1556	126	684	991	1262.5	901.5
Averages:		76.4	900.3	1558.5	126	684.3	991.4	1266.4	898.4

ZALCO LABORATORIES, INC.
Analytical & Consulting Services

4309 Armour Avenue
Bakersfield, California 93308

(661) 395-0539
FAX (661) 395-3069

Catalytica
430 Ferguson Drive
Mountain View CA 94043

Attention: Steve Stein
CC:
Sample Description:
Gas Sample #07180, Ref 1102-131 SAMPLE CONDITIONED TO 1 PSIG/100 DEG F
Sampled 07/20/00 by Client (Client's Cylinder)

Laboratory No: 0007332-1
Date Received: 07/24/2000
Date Analyzed: 07/26/2000
Purchase Order: - -

Date Reprinted: 07/26/2000
Test Code: 1635

CHONS Chromatographic Analysis, ASTM D-1945-81, ASTM D-3588-89, GPA 2145-94

Constituent:	Norm Mol%	Norm Wt%	GPM	CHONS%
				Carbon, C
Oxygen	0.017	0.032		72.64
Nitrogen	1.311	2.189		
				Hydrogen, H
Carbon Dioxide	0.653	1.713		23.90
Carbon Monoxide	0.000	0.000		
				Oxygen, O
Methane	95.589	91.448		1.28
Ethane	2.231	4.001		
Propane	0.136	0.358	0.037	Nitrogen, N
IsoButane	0.015	0.051	0.005	2.19
n-Butane	0.020	0.068	0.006	
IsoPentane	0.006	0.026	0.002	Sulfur, S
n-Pentane	0.004	0.018	0.001	0.00
Hexanes +	0.019	0.095	0.008	
Totals:	100.000	100.020	0.060	100.00

Gas Properties calculated at STP:	degrees F.	60.00	H/C Ratio:
Measurement Base Pressure at STP:	psia	14.695	0.33

Gross Btu/Cu.Ft.,	Dry Gas HHV	1012.9	Relative Gas Density, Ideal gas:		0.5790
Ideal Gross Btu/Lb.	Dry Gas HHV	22873.4	Specific Gravity, (Air = 1) Real gas:		0.5799
Net Btu/Cu.Ft.	Dry Gas LHV	912.7	Real Gas Density, Lb/Cu.Ft.		0.04428
Ideal Net Btu/Lb	Dry Gas LHV	20610.5	Specific Volume, Cu.Ft./Lb		22.5824
Gross Btu/Cu.Ft., water saturated		993.1	Compressibility, Z		0.9979
				Gross or HHV:	Net or LHV:
			"F" Factor, DSCF/MMBtu at 60F.	8519.4	9454.8
			"F" Factor, DSCF/MMBtu at 68F.	8649.1	9598.8
			"F" Factor, DSCF/MMBtu at 70F.	8682.0	9635.2
			"FC" Factor, DSCF CO2/MMBtu60F.	1004.1	1114.3
			"FC" Factor, DSCF CO2/MMBtu68F.	1019.4	1131.3

Jim Etherton
Laboratory Operations Manager

APPENDIX C

Equipment Calibration Results

C.1 Calibration Gas Certifications

C.2 Calibration Results of Ambient Measurement Equipment

C.1 Calibration Gas Certifications

Scott Specialty Gases

RATA CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET,TROY,MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

SCOTT SPECIALTY GASES
1290 COMBERMERE STREET
TROY,MI 48083

P.O. No.: 043766
Project No.: 05-60837-001

Customer

MIDWEST RESEARCH
DAN NEAL
425 VOLKER BLVD
KANSAS CITY MO 64110

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure #G1; September, 1997.

Cylinder Number: ALM048090 **Certification Date:** 5/05/00 **Exp. Date:** 5/05/2002
Cylinder Pressure*:** 1900 PSIG

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ANALYTICAL ACCURACY**	TRACEABILITY
NITRIC OXIDE	201.85	PPM	+/- 1%	Direct NIST and NMi
NITROGEN - OXYGEN FREE		BALANCE		
TOTAL OXIDES OF NITROGEN	203.7	PPM		Reference Value Only

*** Do not use when cylinder pressure is below 150 psig.

** Analytical accuracy is based on the requirements of EPA Protocal procedure G1, September 1997.
Product certified as +/- 1% analytical accuracy is directly traceable to NIST or NMI standards.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1683	4/03/03	ALM033297	48.90 PPM	NITRIC OXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
BECKMAN/951/010177	05/05/00	CHEMILUMINESCENCE

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

NITRIC OXIDE

First Triad Analysis

Date:04/28/00	Response Unit:MV	
Z1 = 0.0000	R1 = 100.00	T1 = 80.300
R2 = 100.00	Z2 = 0.0000	T2 = 80.300
Z3 = 0.0000	T3 = 80.300	R3 = 100.00
Avg. Concentration:	201.5	PPM

Second Triad Analysis

Date: 05/05/00	Response Unit: MV	
Z1 = 0.0000	R1 = 100.00	T1 = 80.700
R2 = 100.00	Z2 = 0.0000	T2 = 80.600
Z3 = 0.0000	T3 = 80.600	R3 = 100.00
Avg. Concentration:	202.2	PPM

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4	
r = .999991	1685
Constants:	A = -.288709
B = 2.594606	C = -1.017189E-3
D = 0	E = 0

APPROVED BY: _____

Scott Specialty Gases

COMPLIANCE CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET,TROY,MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

SCOTT SPECIALTY GASES
1290 COMBERMERE STREET
TROY,MI 48083

P.O. No.: REPLACEMENT 040897
Project No.: 05-59909-001

Customer

MIDWEST RESEARCH

425 VOLKER BLVD
KANSAS CITY MO 64110

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; September, 1997.

Cylinder Number: ALM007829 **Certification Date:** 3/30/00 **Exp. Date:** 3/30/2003
Cylinder Pressure*:** 2000 PSIG

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ANALYTICAL ACCURACY**	TRACEABILITY
OXYGEN	38.4 %	+/- 2%	NIST and NMi
NITROGEN	BALANCE		

*** Do not use when cylinder pressure is below 150 psig.

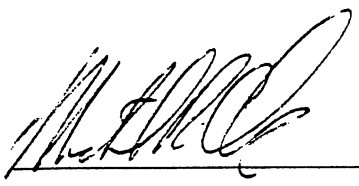
** Analytical accuracy is based on the requirements of EPA Protocal procedures , September 1997.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 2657	1/02/01	ALM032762	1.950 %	OXYGEN

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
ROSEMOUNT/755R/1000430	03/30/00	PARAMAGNETIC

APPROVED BY: 

Scott Specialty Gases

RATA CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET,TROY,MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

SCOTT SPECIALTY GASES
1290 COMBERMERE STREET
TROY,MI 48083

P.O. No.: RECERTIFICATION
Project No.: 05-55275-003

Customer

MIDWEST RESEARCH

425 VOLKER BLVD
KANSAS CITY MO 64110

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure #G1; September, 1997.

Cylinder Number: AAL19060 **Certification Date:** 12/20/99 **Exp. Date:** 12/19/2002
Cylinder Pressure*:** 0900 PSIG

COMPONENT	CERTIFIED CONCENTRATION (Moles)	ANALYTICAL ACCURACY**	TRACEABILITY
CARBON DIOXIDE	40.05 %	+/- 1%	Direct NIST and NMi
NITROGEN	BALANCE		

*** Do not use when cylinder pressure is below 150 psig.

** Analytical accuracy is based on the requirements of EPA Protocal procedure G1, September 1997.
Product certified as +/- 1% analytical accuracy is directly traceable to NIST or NMI standards.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1675	1/01/03	ALM025157	13.96 %	CARBON DIOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
VARIAN/3400/10693	12/20/99	THERMAL CONDUCTIVITY

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

First Triad Analysis

CARBON DIOXIDE

Date:12/20/99	Response Unit:AREA	
Z1 = 0.0000	R1 = 95260.	T1 = 271904
R2 = 95297.	Z2 = 0.0000	T2 = 272105
Z3 = 0.0000	T3 = 271925	R3 = 95131.
Avg. Concentration:	40.05	%

Second Triad Analysis

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4

r = 0.999997	1675
Constants:	A = -0.05308458
B = 0.00014779	C = 0
D = 0	E = 0

APPROVED BY: _____

Scott Specialty Gases

RATA CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET,TROY,MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

SCOTT SPECIALTY GASES
1290 COMBERMERE STREET
TROY,MI 48083

P.O. No.: 043766
Project No.: 05-60837-002

Customer

MIDWEST RESEARCH
DAN NEAL
425 VOLKER BLVD
KANSAS CITY MO 64110

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure #G1; September, 1997.

Cylinder Number: AAL17607 **Certification Date:** 5/02/00 **Exp. Date:** 5/02/2003
Cylinder Pressure*:** 1900 PSIG

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ANALYTICAL ACCURACY**	TRACEABILITY
CARBON MONOXIDE	199.8	PPM	+/- 1%	Direct NIST and NMi
NITROGEN		BALANCE		

*** Do not use when cylinder pressure is below 150 psig.

** Analytical accuracy is based on the requirements of EPA Protocal procedure G1, September 1997.
Product certified as +/- 1% analytical accuracy is directly traceable to NIST or NMI standards.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1681	3/01/03	ALM034513	977.1 PPM	CARBON MONOXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
A1A/220-2/57297601	05/02/00	NDIR

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

First Triad Analysis

CARBON MONOXIDE

Date:04/24/00	Response Unit:MV	
Z1 = 0.0000	R1 = 100.00	T1 = 25.600
R2 = 100.00	Z2 = 0.0000	T2 = 25.600
Z3 = 0.0000	T3 = 25.600	R3 = 100.00
Avg. Concentration:	199.8	PPM

Second Triad Analysis

Date: 05/02/00	Response Unit: MV	
Z1 = 0.0000	R1 = 100.00	T1 = 25.500
R2 = 100.00	Z2 = 0.0000	T2 = 25.600
Z3 = 0.0000	T3 = 25.600	R3 = 100.00
Avg. Concentration:	199.8	PPM

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4	
r = .999997	1681
Constants:	A = .2123653
B = 7.245147	C = 2.034362E-2
D = 4.893673E-5	E = 0

APPROVED BY:

Scott Specialty Gases

RATA CLASS

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET,TROY,MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

SCOTT SPECIALTY GASES
1290 COMBERMERE STREET
TROY,MI 48083

P.O. No.: 043766
Project No.: 05-60837-003

Customer

MIDWEST RESEARCH
DAN NEAL
425 VOLKER BLVD
KANSAS CITY MO 64110

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure #G1; September, 1997.

Cylinder Number: ALM023230 **Certification Date:** 5/05/00 **Exp. Date:** 5/05/2003
Cylinder Pressure*:** 2000 PSIG

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ANALYTICAL ACCURACY**	TRACEABILITY
PROPANE	190.6	PPM	+/- 1%	Direct NIST and NMi
NITROGEN		BALANCE		

* Do not use when cylinder pressure is below 150 psig.

** Analytical accuracy is based on the requirements of EPA Protocal procedure G1, September 1997. Product certified as +/- 1% analytical accuracy is directly traceable to NIST or NMI standards.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1669	10/02/02	ALM025209	497.0 PPM	PROPANE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
VARIAN/1400/08982426	05/05/00	FLAME IONIZATION

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

First Triad Analysis

PROPANE

Date:05/05/00	Response Unit:PPM	
Z1 = 0.0000	R1 = 12960.	T1 = 4978.1
R2 = 12960.	Z2 = 0.0000	T2 = 4955.4
Z3 = 0.0000	T3 = 4973.3	R3 = 12960.
Avg. Concentration:	190.6	PPM

Second Triad Analysis

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4
r = 1.00000

Constants:	A = -5.236957E02
B = 3.835281E-02	C = 0
D = 0	E = 0

APPROVED BY:

RATA CLASS

Scott Specialty Gases

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET,TROY,MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

SCOTT SPECIALTY GASES
1290 COMBERMERE STREET
TROY,MI 48083

P.O. No.: 044167
Project No.: 05-61970-002

Customer
MIDWEST RESEARCH

425 VOLKER BLVD
KANSAS CITY MO 64110

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure #G1; September, 1997.

Cylinder Number: AAL7388 **Certification Date:** 6/01/00 **Exp. Date:** 6/01/2002
Cylinder Pressure***: 1900 PSIG

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ANALYTICAL ACCURACY**	TRACEABILITY
NITRIC OXIDE	25.59	PPM	+/- 1%	Direct NIST and NMi
NITROGEN - OXYGEN FREE		BALANCE		
TOTAL OXIDES OF NITROGEN	25.7	PPM		Reference Value Only

*** Do not use when cylinder pressure is below 150 psig.

** Analytical accuracy is based on the requirements of EPA Protocol procedure G1, September 1997.

Product certified as +/- 1% analytical accuracy is directly traceable to NIST or NMI standards.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
SRM 2629A	6/03/01	CAL01C987	18.93 PPM	NITRIC OXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
HORIBA/OPE235/583956034	06/01/00	CHEMILUMENECENCE

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

First Triad Analysis

NITRIC OXIDE

Date:05/22/00	Response Unit:MV	
Z1 = 0.00000	R1 = 100.0000	T1 = 51.00000
R2 = 100.0000	Z2 = 0.00000	T2 = 50.70000
Z3 = 0.00000	T3 = 50.70000	R3 = 100.0000
Avg. Concentration:	25.58	PPM

Second Triad Analysis

Date: 06/01/00	Response Unit: MV	
Z1 = 0.00000	R1 = 100.0000	T1 = 50.90000
R2 = 100.0000	Z2 = 0.00000	T2 = 50.90000
Z3 = 0.00000	T3 = 50.80000	R3 = 100.0000
Avg. Concentration:	25.59	PPM

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4	
r = 1.0	2629A
Constants:	A = 0.001376
B = 0.511783	C = -0.00017
D = 0	E = 0

APPROVED BY:

RATA CLASS

Scott Specialty Gases

Dual-Analyzed Calibration Standard

1290 COMBERMERE STREET, TROY, MI 48083 Phone: 248-589-2950 Fax: 248-589-2134

CERTIFICATE OF ACCURACY: EPA Protocol Gas

Assay Laboratory

SCOTT SPECIALTY GASES
1290 COMBERMERE STREET
TROY, MI 48083

P.O. No.: 044167
Project No.: 05-61970-001

Customer

MIDWEST RESEARCH

425 VOLKER BLVD
KANSAS CITY MO 64110

ANALYTICAL INFORMATION

This certification was performed according to EPA Traceability Protocol For Assay & Certification of Gaseous Calibration Standards; Procedure #G1; September, 1997.

Cylinder Number: ALM055608 **Certification Date:** 6/01/00 **Exp. Date:** 6/01/2002
Cylinder Pressure*:** 1900 PSIG

COMPONENT	CERTIFIED CONCENTRATION (Moles)		ANALYTICAL ACCURACY**	TRACEABILITY
NITRIC OXIDE	503.45	PPM	+/- 1%	Direct NIST and NMi
NITROGEN - OXYGEN FREE		BALANCE		
TOTAL OXIDES OF NITROGEN	506.66	PPM		Reference Value Only

*** Do not use when cylinder pressure is below 150 psig.

** Analytical accuracy is based on the requirements of EPA Protocol procedure G1, September 1997. Product certified as +/- 1% analytical accuracy is directly traceable to NIST or NMI standards.

REFERENCE STANDARD

TYPE/SRM NO.	EXPIRATION DATE	CYLINDER NUMBER	CONCENTRATION	COMPONENT
NTRM 1686	2/01/03	AAL9242	495.3 PPM	NITRIC OXIDE

INSTRUMENTATION

INSTRUMENT/MODEL/SERIAL#	DATE LAST CALIBRATED	ANALYTICAL PRINCIPLE
TECKMAN/951/010177	06/01/00	CHEMILUMINESCENCE

ANALYZER READINGS

(Z = Zero Gas R = Reference Gas T = Test Gas r = Correlation Coefficient)

NITRIC OXIDE

First Triad Analysis

Date:05/23/00 Response Unit:MV

Z1 = 0.00000	R1 = 100.0000	T1 = 49.70000
R2 = 100.0000	Z2 = 0.00000	T2 = 49.80000
Z3 = 0.00000	T3 = 49.80000	R3 = 100.0000

Avg. Concentration: 503.3 PPM

Second Triad Analysis

Date: 06/01/00 Response Unit: MV

Z1 = 0.00000	R1 = 55.00000	T1 = 56.20000
R2 = 55.00000	Z2 = 0.00000	T2 = 55.80000
Z3 = 0.00000	T3 = 55.90000	R3 = 56.00000

Avg. Concentration: 503.6 PPM

Calibration Curve

Concentration = A + Bx + Cx2 + Dx3 + Ex4

r = .999997	1686
Constants:	A = 9.398621
B = -0.00689	C = 0
D = 0	E = 0

APPROVED BY:

C.2 Calibration Results of Ambient Measurement Equipment

ANEROID BAROMETER CALIBRATION CHECK

Location:	Kansas City, Missouri
Altitude Above Sea Level:	850 feet
Latitude:	39° 05.8' north
Meteorological Gravity:	32.1551 feet/second²
Mercury Barometer Description:	Sargent Welch, Cat. S-4519, Lot 791802000

MRI Project No.	101494.1.004.02
Date:	6/9/2000
Time:	07:15
Readings Obtained By:	D. Neal
Observed Barometer Reading:	29.22 in. Hg
Mercury Column Temperature:	70 °F
Correction For Temperature:	-0.11 in. Hg
Correction For Gravity:	-0.02 in. Hg
Corrected Barometric Pressure:	29.09 in. Hg

Aneroid Barometer I.D. No.:	Y-2101
Reading Before Adjustment:	29.08 in. Hg
Calibration Check Result:	within 0.1 in. Hg
Reading After Adjustment:	29.08 in. Hg

Remarks:

BAROMETR.WK4 10/19/98 (rev. BAROMETR.WK4 06/09/2000 07:18 AM)

Hygrometer Calibration

MRI # Y-6117 Model # Testo 615 Serial # 00269890

Hygrometer type: Digital Manufacturer: Cole Parmer

Reference Solution(s) used:

1. Salt: LiCl (5440-75) Date of preparation: 12-3-99 Approximate Humidity: 11.3
   Ref. Document: ☐ ASTM E 104-85 (1991) ☒ J. Res. NBS, 81A, 89, 1977.
2. Salt: K_2CO_3 (5440-76) Date of preparation: 12-3-99 Approximate Humidity: 43.2
   Ref. Document: ☐ ASTM E 104-85 (1991) ☒ J. Res. NBS, 81A, 89, 1977.
3. Salt: NaCl (5440-89) Date of preparation: 3-20-00 Approximate Humidity: 75.4
   Ref. Document: ☐ ASTM E 104-85 (1991) ☒ J. Res. NBS, 81A, 89, 1977.

Reference Thermometer used: 1521 Accuracy: ± 0.013°C

MRI # Y-6600 Serial # 98063 Date last Certification: 8-19-99

As Found: Temperature: Hygrometer = 21.8°C STD = 21.8°C Tolerance = ± 0.4°C

Reference temperature (°C)	Temperature instability + uncertainty[a]	Reference system humidity	Reference system uncertainty (incl. T-rel.)[b]	Hygrometer reading	Hygrometer acceptance criteria
22.9	+ N/A =	11.3	< 1	10.0	± 3
22.6	+ N/A =	43.2	< 1	40.3	± 3
22.6	+ =	75.4	< 1	70.8	± 3

As Left: Temperature: Same

22.9	+ =	11.3	< 1	12.4	± 3
22.6	+ N/A =	43.2	< 1	42.6	± 3
22.6	+ =	75.4	< 1	73.8	± 3

[a] Uncertainty due to accuracy limits of ref. thermometer (in ±°C).
[b] Includes stated uncertainty of the system from the literature plus uncertainties derived from the temperature uncertainty column (use linear interpolation of the temperature/humidity tables from the literature).
Calculation: N/A

This hygrometer ☒ **Passed** ☐ **Failed** Calibration.

This hygrometer has been tagged.

Performed by: Dave Lipton Date: 6-6-00

Reviewed by: [signature] Date: 6/8/00

Attachment 1

Instrument Found Out of Tolerance

Instrument: Digital Hygrometer Testo 615

Manufacturer: Cole Parmer

MRI Number: Y-6117

Serial Number: 00269890

Acceptance Criteria: ± 3% RH

Date of calibration or test that revealed the out of tolerance condition: 6-6-00

Date of previous calibration: 10-26-99

Responsible person: D Neal (Must receive a copy of this report)

Tested/Calibrated by: Dave Upton Date: 6-6-00

Reviewed by: [signature] Date: 6/8/00

Comments/details of out of tolerance condition:

Hygrometer read 4.6% RH low at 75%

Hygrometer was adjusted to meet tolerance

I hereby certify that I have received a copy of this report and will notify the appropriate people and take the appropriate actions necessary to determine what data may have been corrupted and what corrective actions are indicated.

Signed: [signature] (Responsible person)

Date: 6-8-00

NEW INSTRUMENT, NEVER USED.

Hygrometer Calibration

MRI # Y-6118 Model # Testo 615 Serial # 00318990

Hygrometer type: Digital Manufacturer: Cole Parmer

Reference Solution(s) used:

1. Salt: LiCl 5446-75 Date of preparation: 12-3-99 Approximate Humidity: 11.3%
   Ref. Document: ☐ ASTM E 104-85 (1991) ☒ J. Res. NBS, 81A, 89, 1977.
2. Salt: K_2CO_3 Date of preparation: 12-3-99 Approximate Humidity: 43.2
   Ref. Document: ☐ ASTM E 104-85 (1991) ☒ J. Res. NBS, 81A, 89, 1977.
3. Salt: NaCl Date of preparation: 3-20-00 Approximate Humidity: 75.4
   Ref. Document: ☐ ASTM E 104-85 (1991) ☒ J. Res. NBS, 81A, 89, 1977.

Reference Thermometer used: 1521 Accuracy: ±0.013°C

MRI # Y-6600 Serial # 98063 Date last Certification: 8-19-99

As Found: Temperature: Hygrometer = 22.2°C STD = 22.1°C Tolerance ±0.4°C

Reference temperature (°C)	Temperature instability + uncertainty[a]	Reference system humidity	Reference system uncertainty (incl. T-rel.)[b]	Hygrometer reading	Hygrometer acceptance criteria
22.5	+ =	11.3	< 1	12.9	±3
22.5	+N/A =	43.2	< 1	42.5	±3
22.5	+ =	75.4	< 1	73.2	±3

As Left: Temperature: Same

	+ =				
	+ =	SAME			
	+ =				

[a] Uncertainty due to accuracy limits of ref. thermometer (in ±°C).
[b] Includes stated uncertainty of the system from the literature plus uncertainties derived from the temperature uncertainty column (use linear interpolation of the temperature/humidity tables from the literature).
Calculation: N/A

This hygrometer ☒ **Passed** ☐ **Failed** Calibration.

This hygrometer has been tagged.

Performed by: Dave Upton Date: 6-6-00

Reviewed by: [signature] Date: 6/8/00